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FINAL
WORK PLAN

WHITMOYER LABORATORIES SITE
JACKSON TOWNSHIP
LEBANON COUNTY, PENNSYLVANIA

JUNE 1988
W.A. NO. 200-3L09

300098

EBASCO SERVICES INCORPORATED

EBASCO

160 Chubb Avenue. Lyndhurst. NJ 07071 · (201) 460-1900

June 10, 1988
RM/III/88-0259

Mr. Jeffrey Pike
Environmental Protection Agency
Region III
841 Chestnut Street
Philadelphia, PA 19107

Subject: REM III PROGRAM - EPA CONTRACT NO. 68-01-7250
WORK ASSIGNMENT NO. 200-3L09
WHITMOYER LABORATORIES SITE, JACKSON TWP., PENNSYLVANIA
FINAL RI/FS WORK PLAN

Dear Mr. Pike:

Enclosed for your review are twelve (12) copies (11 bound and 1 unbound) of the Final RI/FS Work Plan for the Whitmoyer Laboratories Site. The RI/FS Work Plan has been revised, based on EPA and PADER comments received at the May 16, 1988 Work Plan Review Meeting and in subsequent discussions. The supporting REM III Team level of effort and cost estimates for conducting this work are being sent to you under separate cover. These estimates have been modified based on revisions to the original (draft) scope of work.

In accordance with the project schedule, we look forward to your approval of this Final RI/FS Work Plan and budget by June 20, 1988.

If you have any questions or comments regarding this report, please feel free to contact me or our Site Manager, Mr. George J Latulippe at (412) 788-1080.

Very truly yours,

Richard C Evans, P.E.
Regional Manager, Region III

RCE/GJL/ddh

Enclosures

cc: S Del Re - EPA, Region III (w/o attachment)
P Krantz - Central Regional Laboratory
M Yates - ZPMO
S Missailidis - ZPMO
M Amdurer - ZPMO
L Johnson - NUS
G Latulippe - NUS

File: Whitmoyer Laboratories Site (1$17/563)
Daily

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JUNE 1988

FINAL
WORK PLAN

WHITMOYER LABORATORIES SITE
JACKSON TOWNSHIP
LEBANON COUNTY, PENNSYLVANIA

EPA WORK ASSIGNMENT NUMBER 200-3L09
UNDER
CONTRACT NUMBER 68-01-7250

PREPARED BY:
NUS CORPORATION
PITTSBURGH, PENNSYLVANIA

APPROVED BY:
EBASCO SERVICES INCORPORATED
LANGHORNE, PENNSYLVANIA

PREPARED BY:

GEORGE J LATULIPPE
SITE MANAGER
NUS CORPORATION

APPROVED BY:

RICHARD C EVANS, P.E.
REGIONAL MANAGER, REGION III
EBASCO SERVICES INCORPORATED

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1.0 INTRODUCTION

NUS Corporation (NUS), under contract to Ebasco Services Incorporated (Ebasco), is pleased to submit this Final Work Plan for the Whitmoyer Laboratories Site Remedial Investigation/ Feasibility Study (RI/FS) to the U.S. Environmental Protection Agency (EPA). Preparation of this Work Plan was accomplished in response to Work Assignment Number 200-3L09 under EPA Contract Number 68-01-7250 pursuant to the Work Plan Memorandum (WPM) dated November 16, 1987.

The Work Plan describes the scope of work, resources, and budget necessary for the collection of data needed to assess present and potential health and environmental risks and to evaluate the feasibility of potential remedial alternatives for the Whitmoyer Laboratories Site. The methodology and approach used to establish the project objectives and the RI/FS scope of work follow the latest EPA and REM III guidance for planning and implementing a remedial investigation and feasibility study. This guidance is based on the requirements of the Superfund Amendments and Reauthorization Act (SARA) of 1986, which emphasizes the RI/FS "scoping process" and a phased RI and FS.

The site contains approximately 30 areas where contamination is known to or may exist. Where contaminant source areas are known to exist, RI/FS efforts under this Work Plan will attempt to completely characterize these areas. However, additional efforts beyond the scope of this Work Plan may be necessary, since it is unknown whether many of the potential source areas on site are contaminated, and an iterative, phased approach will be most economic in characterizing these areas. Additionally, if the extent of process building, surface soil, subsurface soil, and groundwater contamination at the site is greater than anticipated, additional efforts may be necessary to further identify the extent of contamination. If additional efforts beyond the scope of this RI/FS Work Plan are necessary, a Technical Decision Memorandum (TDM) will be prepared.

The RI/FS Work Plan consists of 6 sections, including this Introduction (Section 1.0). Section 2.0 provides a description of the site location, general layout, and physical characteristics; site history; and a summary of existing data. Section 3.0 outlines the scoping of the Phase I RI/FS and includes the following:

- Results of the preliminary risk assessment.
- Listing of Applicable or Relevant and Appropriate Requirements (ARARs).
- Summary of potential remedial alternatives.
- Listing of data limitations and requirements.
- Description of the specific project objectives.
- Summary of Data Quality Objectives (DQOs).
- Technical approach for the RI Field Investigation.

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Eight tasks have been identified to conduct the Phase I RI for the Whitmoyer Laboratories Site. Section 4.0 of this report describes the methodology for implementing these tasks. The FS tasks (Tasks 9 through 12) are described in Section 5.0. Project management activities, including the project organization, quality assurance, and data management, and schedule are provided in Section 6.0. Cost estimates are provided under separate cover.

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2.0 SUMMARY OF EXISTING DATA

This characterization of the Whitmoyer Laboratories Site summarizes existing data which have been compiled from two recent site visits; a review of existing literature and regulatory agency files; and recent fieldwork by EPA's Technical Assistance Team (TAT), Environmental Response Team (ERT) and the Pennsylvania Department of Environmental Resources (PADER). A PADER representative spent 11 days reviewing the plant's operating files and copying items pertinent to this investigation. Since this material was made available to the investigators, the onsite files were not revisited by the REM III RPM.

2.1 SITE HISTORY

The Whitmoyer Laboratories Site is located on approximately 22 acres in Jackson Township, Lebanon County, Pennsylvania, about 1 mile southwest of the borough of Myerstown (see Figure 2-1). The site lies between the Union Canal of Tulpehocken Creek and the Conrail (Reading) Railroad. Fairfield Avenue forms the site's eastern boundary, while Creamery Street adjoins the site to the west.

Land surrounding the site is predominantly farmland, with scattered farmhouses. A Sterling Drug factory is located 2,000 feet east of the site, while PJ Valves, a manufacturing plant, is located about 1,500 feet to the south. A large active limestone quarry, locally referred to as the Calcite Quarry, is located approximately 1.5 miles west of the site.

The Union Canal branches from Tulpehocken Creek just west of the site and rejoins the creek near the site's eastern boundary. Tulpehocken Creek joins the Schuylkill River near Reading, Pennsylvania. The Schuylkill River flows into the Delaware River, which eventually empties into the Atlantic Ocean. Tulpehocken Creek (and the Schuylkill River) serve as drinking water supplies and irrigation sources downstream of the site.

The earliest activity at the site occurred in the early 1900s, when an oil pipeline was constructed across the site. Onsite storage tanks were also part of the pipeline's operations. This activity probably was performed by Tuscarora Oil Company or a predecessor.

In September, 1934, C W Whitmoyer formed Whitmoyer Laboratories, Inc. (WLI), by merging his operations with another animal pharmaceutical company. WLI filed to do business in Pennsylvania in the following months. Little documentation of WLI operations prior to 1957 exists. Aerial photography indicates that some production was occurring, but no records regarding feedstocks, products, and/or quantities were identified.

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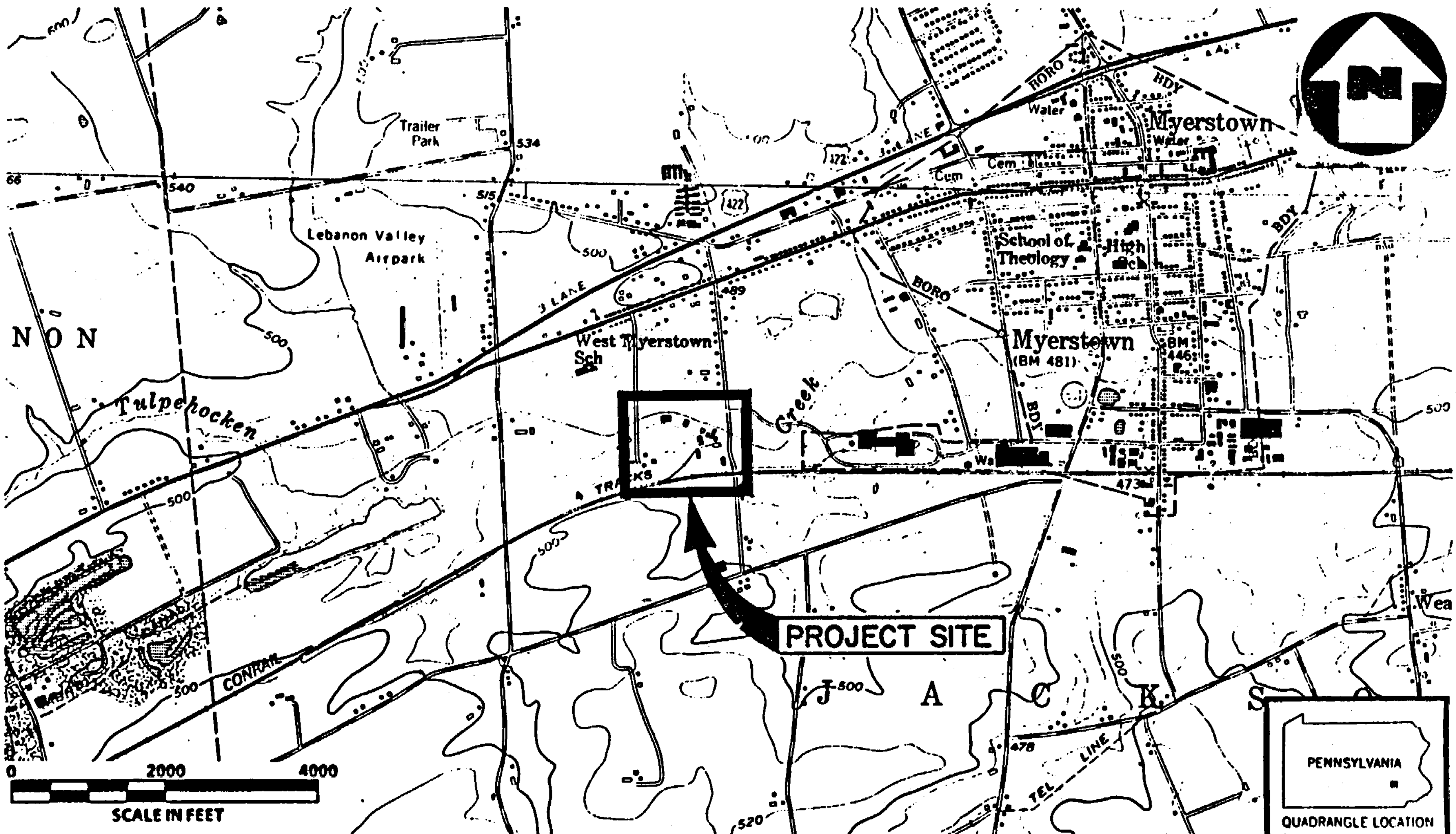

BASE MAP IS A PORTION OF THE U.S.G.S. RICHLAND, PA QUADRANGLE (7.5 MINUTE SERIES, 1955, PHOTOREVISED 1969). CONTOUR INTERVAL 20'.

FIGURE 2-1

LOCATION MAP
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA
SCALE: 1" = 2000'

NUS CORPORATION

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Aerial photography from 1951 indicates that some unspecified activity was occurring at the site. At this time Buildings 1-5 (see Figure 2-2) had been constructed, as were the tanks located to the south of Buildings 4 and 5. Additionally, mounded material, a probable pit, and possible drums were identified. Construction work along the pipeline had recently occurred, and a rail spur to the site was being constructed. The 2 large dikes which were later utilized as lagoons were also evident.

In 1957 the production of organic arsenicals reportedly commenced at the site. Two primary products, arsanilic acid and carbarsone (p-ureidobenzenearsonic acid), were manufactured. The primary organic chemical used was aniline. Coal tar dip, piperazine, sulfa products, biodin, and ethylenediamine dihydroiodide (EDDI) were also produced in 1964. Wastewater from all of these processes was routed to an unlined lagoon, which was constructed inside of the easternmost dike previously emplaced around an oil storage tank. The lagoon was constructed directly on top of bedrock.

Lime was added to the process wastewater to precipitate arsenic. The arsenic precipitate consisted of calcium arsenate, calcium arsenite, and organically bound arsenic. Estimates of the quantity of arsenic placed in the unlined lagoon range as high as 4,000,000 pounds or more. The lagoon occupied the same area as the consolidated lagoons shown on Figure 2-2.

In 1964 WLI was bought by and became a wholly owned subsidiary of Rohm & Haas (R&H). In late 1964 the arsenic pollution problem caused by wastewater disposal in the unlined lagoon was first noted. An investigation was conducted by R&H and significant soil, surface-water, and groundwater contamination was identified.

Surface water at the site assayed at 40-60 mg/l arsenic. Approximately 1,900 to 3,200 pounds of arsenic per day were leaving the site in surface water. Arsenic contamination was traced from Tulpehocken Creek/Union Canal as far as the Schuylkill River-Delaware River confluence in Philadelphia.

Groundwater arsenic contamination reached 10,000 mg/l on site. More than 30 residential wells in the vicinity of the site were found to be contaminated with high levels of arsenic. At least two individuals were reportedly hospitalized with chronic arsenic poisoning from ingestion of their well water. The area of groundwater pollution was approximately 1 mile wide by 6 miles long, radiating in all directions from the site.

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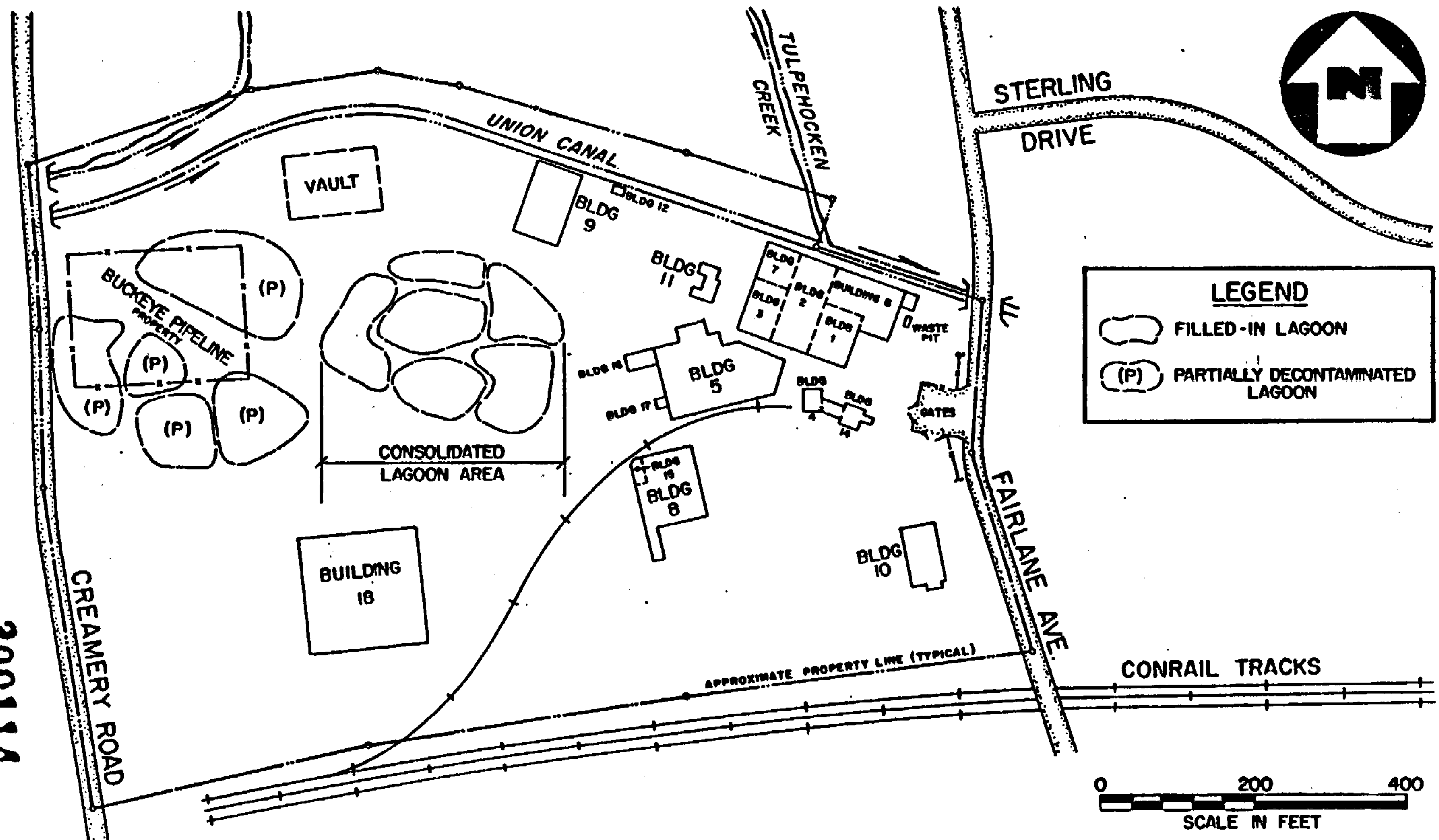

SOURCE: GENERAL LAYOUT DRAWING, PREPAREDNESS, PREVENTION & CONTINGENCY PLAN, DEC. 22, 1982.

FIGURE 2-2

NUS CORPORATION

GENERAL ARRANGEMENT
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

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Once this contamination was identified, a three-phased remediation effort was initiated. This effort consisted of:

- Termination of process wastewater disposal in the lagoon and excavation of lagoon sludges and other hot spots.

- Groundwater pumping and treatment.

- Supply of bottled water to nearby residents with contaminated wells.

At the same time (late 1964), R&H temporarily ceased operations, waiting until R&H felt the contamination problems had been sufficiently addressed before resuming production. In the spring of 1965 production of organic arsenicals and other chemicals at the Whitmoyer plant was resumed on a no-arsenic-discharge basis. Treated arsenic wastes were trucked to Paulsboro, New Jersey, and dumped in the ocean.

A concrete vault measuring 123 feet long by 83 feet wide and 12 feet deep was constructed in late 1964 and early 1965 to accept the lagoon sludges and other contaminated material. The walls were coated with a bitumastic sealant. An estimated 3.75-4.0-million pounds of arsenic were placed in the vault. The plywood roof was added to the vault at an unspecified later date (possibly as late as 1978).

Two separate scattered piles of diamino diphenyl arsenic acid (DDAA), which is a waste product, were being held on the property for later arsenic recovery. These piles, which together weighed about 2.0 million pounds, were also excavated and drummed as part of the cleanup effort. The drums were temporarily stored off site in a barn until 1968. This material was reportedly recycled later. About 250 drums of contaminated soil underlying the DDAA stockpile were deposited in the vault.

As part of the cleanup, 1,455 drums probably containing aniline still bottoms which had been deposited at the nearby Schaefferstown Quarry were removed from the quarry back to the site. These drums were reportedly placed in the vault.

The extraction and treatment of contaminated groundwater was initiated concurrently with the excavation project, i.e., in December 1964. Initially 4 previously abandoned wells were used to extract the contaminated groundwater. Weekly yields of arsenic peaked at 11,000 pounds early in the project, and quickly fell to 4,500 to 5,000 pounds by April 1965. Three additional extraction wells were brought onstream in June 1965 to bring the extraction rate from 40 gpm up to 70 gpm, but arsenic yields continued to gradually decrease. Seven additional recovery wells were drilled and activated by the end of 1966, increasing the extraction rate to 140 gpm. While these additional wells increased arsenic production in the near term, the well yields eventually decreased again, to a level of 500 to 700 pounds per week by April 1968. The cumulative amount of

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arsenic extracted in the groundwater by the end of 1968 was 400,000 pounds. No comparable analyses for aniline or other contaminants were performed, as these were not contaminants of concern at that time and were not measured.

The extracted water was treated with ferric sulfate and flocculant to precipitate ferric arsenate and reduce the water concentration to 1-5 mg/l arsenic. The ferric arsenate was allowed to precipitate in the existing lagoons, which had been compartmentalized into eight lagoons and refurbished. Additional lagoons were also constructed to the west of the original lagoon(s) to provide added settling capacity (see Figure 2-2). Some of these lagoons were lined with 6 inches of topsoil, while others were lined with 6 to 8 inches of clay. When completed, the lagoons covered approximately 2.5 acres.

With the exception of the thin liner, no effort was made to keep the treated wastewater from re-entering groundwater. In fact, infiltration was encouraged so that greater pumping rates could be achieved without necessitating a discharge to the sewer or surface water. During the pump and treat program an estimated 3 pounds of unprecipitated arsenic per day was re-entering groundwater via infiltration from the lagoons.

Due to the cost of groundwater treatment, the desire to expand the cone of depression of the pumping network (by limiting reinfiltration), the desire to minimize the accumulation of arsenic precipitate, and the lower concentration of groundwater being pumped, R&H petitioned and received permission to discharge extracted, untreated, groundwater directly to Tulpehocken Creek in December 1968. Direct discharge commenced shortly thereafter. This discharge was temporarily halted in April 1969 because of the start of the fishing season, but reinitiated the following September, when the season ended.

In 1970 a program of overstressing was attempted to assist flushing of contaminants from the subsurface soils. This program consisted of ponding Union Canal water on the lagoons, municipal water near well No. 3, and spent cooling water (in a trench) near well No. 7, and allowing these waters to infiltrate to the subsurface. As arsenic yields did not significantly increase with this approach, it was abandoned shortly thereafter.

In March 1971, because of public and regulatory opposition to continued untreated discharge of contaminated groundwater to Tulpehocken Creek and R&H's reticence to resume groundwater treatment, R&H ceased operation of their pumping wells. Reportedly 50,000 pounds of arsenic was extracted and discharged to Tulpehocken Creek from December 1968 until pumping was halted. The discharge rate was as high as 250,000 gpd during this period.

Adding the 50,000 pounds of arsenic removed from December 1968 until the March 1971 end of pumping to the amount removed from

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December 1964 through December 1968 gives a total of 450,000 pounds of arsenic removed from groundwater during the extraction program.

In 1965 R&H also conducted an augering and coring program to evaluate the arsenic concentration of subsurface soil and rock. As expected, with arsenic's affinity for soil adsorption, the lower layers of the soil mantle (which were in contact with groundwater) had accumulated significant amounts of arsenic (the available 1965 analytical results for the soil directly above bedrock averaged 1,500 mg/kg). Most of this accumulation had occurred around and along the contact surface between the soil mantle and the underlying rock formations. The majority of this contamination is reportedly localized within the plant boundaries. The soil's arsenic accumulations were later confirmed during a 1973 United States Geological Survey (USGS) study. A USGS conclusion was that the majority of the arsenic in the soil in 1965 had remained there through the pump and treat program.

In 1970 R&H amended their process for producing arsanilic acid. At this time, perchloroethylene (PCE) was introduced as a process chemical at the plant.

In March 1971 public opposition to ocean dumping of the plant wastes caused R&H to abandon this disposal method. Since R&H had no way of disposing its waste solutions, production of arsanilic acid and carbarsone was temporarily suspended. In 1972, R&H introduced a process whereby they evaporated (boiled) the waste solutions, followed by centrifuging and drumming the remaining waste for landfill disposal off site. When this was approved, production commenced once again.

During the week of May 17, 1976, the USEPA Annapolis Field Office, with assistance from PADER, conducted an investigation of the Myerstown Sewage Treatment Plant. The primary study objective was to determine the pollutants and their sources that were interfering with the plant's operations and causing the plant's discharge limitations for arsenic and other criteria to be exceeded. Six industrial sewer discharges, including WLI's, were sampled. An arsenic materials balance indicated that nearly 94 percent of the arsenic load reaching the plant was not attributable to the industrial discharges. It was concluded that contaminated groundwater infiltration through cracked sewer lines near the WLI site was the probable source.

Following this conclusion, WLI conducted additional studies and discovered several infiltration points on their property. Most, if not all, of these leaks were repaired.

In late 1976 and 1977, R&H consolidated the lagoon sludges. Sludge containing 200,000 pounds of arsenic was excavated from the westernmost lagoons and placed in the easternmost lagoons (see Figure 2-2). The consolidation raised the receiving lagoons' height from 5 to 8 feet on average.

Some sludge seeped into bedrock fractures in the bottoms of the abandoned lagoons. This sludge was left in place. To restrict movement of the remaining material, R&H reportedly placed a 1/4- to 1/2-inch-thick layer of bentonite over the excavated lagoons. The clay was wetted and covered with 1.5 to 2 feet of earth. Following cover placement, the earth was seeded to prevent erosion.

No records revealing the nature of the cover material used for the consolidated lagoons were identified. This area is well vegetated.

In the mid-70s WLI was required to get an air permit for their stack emissions from the evaporation wastewater treatment process. Contaminants of concern for which WLI monitored included arsenic and aniline (some of the arsenic products, e.g., alkyl arsines, were volatile).

In the summer of 1978, a portion of the stack emissions condensed and dropped out in the nearby farmers' fields. This fallout damaged one farmer's corn crop planted directly east of the site. Investigating PADER representatives believed arsenic was the contaminant which damaged the corn. Cattle were reportedly attracted to the fallout areas because of the high salt content.

In 1978 Beecham Laboratories of Clifton, New Jersey, purchased WLI from R&H. The plant managerial staff remained essentially intact.

In 1979 Buckeye Oil Company repaired a section of pipeline running through the site. In the course of these repairs, underground excavations uncovered a burial ground containing old rusted metal and deteriorated fiber drums which contained arsenical waste products. It was reported that this area was used as a small dumping ground and covered over around 1958 or 1959. The burial area, which was approximately 30 feet by 40 feet and about 7 feet deep, was excavated and disposed off site.

On May 14, 1982, Beecham sold WLI to Stafford Laboratories, Inc., of Phoenix, Arizona. Again the plant managerial staff remained essentially intact.

In July to November 1982, WLI concern about arsenic and organic contaminants leaving the property was raised, and a small pumping program using existing Well No. 7 was initiated. Water was pumped from this well into a specially-heated truck and evaporated. From program inception to completion, aniline concentrations decreased, but arsenic and PCE concentrations did not. Since the arsenic and PCE concentrations did not decline, the program was halted in November.

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On February 9, 1984, EPA's TAT conducted an assessment of the Whitmoyer Laboratories Site. Samples for arsenic only were collected from Tulpehocken Creek both upstream and downstream of the site, from Union Canal on the site property, from two on-site wells and from a nearby residential well. Elevated levels of arsenic were detected in the downgradient surface water and sediment and on site monitor well samples. The results are discussed in Section 2.2.5.

During the TAT investigation, organic vapors were detected by a photoionization detector. To confirm organic contamination, TAT again sampled on February 17, 1984. During this sampling event, samples were again collected from the two on-site wells and also from liquid and sediment present in a borehole located adjacent to the vault. The samples were analyzed for aniline, volatiles, and base/neutral/acid extractable compounds. Elevated levels of organics were detected in all of these samples. These results are also discussed in Section 2.2.5.

In January 1984 WLI developed a process to produce chlorohexidine. Production reportedly commenced shortly thereafter.

Stafford Laboratories, WLI's parent corporation, filed for bankruptcy in the summer of 1984.

On May 17, 1985, WLI submitted a revised RCRA Hazardous Waste Treatment and Storage Closure Plan to PADER. This closure plan only related to the then-current hazardous waste activities. The closure plan called for all containerized waste to be shipped off site to a permitted treatment, storage, or disposal (TSD) facility within 90 days of plan implementation. Additionally, all liquid wastes stored in tanks, sludge remaining in the bottoms of tanks, waste generated during closure of the WLI plant, and contaminated soil identified during closure were to be transported off site to a TSD facility. Following implementation of the plan, WLI was no longer to treat and store hazardous waste, except within the 90-day storage limit for a RCRA hazardous waste generator, i.e., wastewater evaporation was to be discontinued. At the same time WLI sought a RCRA hazardous waste generator status. This closure plan was reportedly signed in 1985. It is unclear when waste evaporation actually ceased at the site.

In 1985 and 1987 the PADER Bureau of Environmental Control sampled nearby residential wells for volatile organics and arsenic. Elevated levels of arsenic, PCE, trichloroethylene (TCE), 1,1-dichloroethylene, 1,1-dichloroethane, trans-1,2-dichloroethene, cis-1,2-dichloroethylene, 1,1,1-trichloroethane, and toluene were detected. The results are presented in Section 2.2.5.

The WLI plant reportedly last operated in January of 1987. These operations were said to be only of a limited scale. It is unclear what portion of the closure plan has been implemented to date. Laboratory wastes and drums have been observed on site.

300119

Some of the wastewater tanks on site are reportedly full (leaks from tank piping have also been observed). Reportedly 400 drums of hazardous waste remain on site.

In February 1987 USEPA's Environmental Response Team (ERT) sampled two bodies of water of interest, the Myerstown Pond and the Lakeside Quarry east of Myerstown, for arsenic. The water samples contained 14 µg/l and 17 µg/l of arsenic, respectively; these concentrations are lower than the present Primary Drinking Water Standard (50 µg/l). A sediment sample from the Lakeside Quarry was also collected. This sample contained a relatively small quantity of arsenic (24 mg/kg).

In July 1987 USEPA's TAT sampled offsite surface and subsurface soil, soil from the banks of Union Canal, the lagoon sludge material, the vault contents, and surface water and sediment from Union Canal and Tulpehocken Creek for arsenic. Elevated levels were detected in the lagoon, vault, offsite soils, and downgradient surface water and sediment samples. The results are discussed in Section 2.2.5 below.

Also in July 1987, the TAT conducted ground-penetrating radar (GPR) and magnetometer surveys of the lagoon areas to determine the lagoons' volumetric extent and if buried drums were present in the lagoons. A small area of possibly buried drums (less than 10 drums) was identified. The results are discussed in Section 2.2.5 below.

On November 4 and 5, 1987, USEPA's TAT sampled 24 offsite residential and industrial wells for VOAs and arsenic. Elevated levels of arsenic, PCE, TCE, 1,1-dichloroethane, and 1,1,1-trichloroethane were detected in several of the wells. The results are discussed in Section 2.2.5 below.

2.1.1 Site Status

Based on the USEPA TAT's February 1984 samples, the Whitmoyer Laboratories Site was proposed for the National Priority List (NPL) in October 1984. The site was finalized on this list in June 1986, and is currently ranked 244th on the list.

As stated above, WLI reportedly entered into a RCRA closure agreement in 1985. However, when WLI finished operations in 1987, many of the items called for in the plan were not implemented. It is unclear what portion of the closure plan has been implemented to date. Laboratory wastes and drums have been observed on site. Leaks from the tank piping have also been observed. Reportedly 400 drums of hazardous waste remain on site; some of the wastewater tanks are also reportedly full.

The USEPA is presently effecting an emergency response at the site to hook up citizens with contaminated residential wells to the Myerstown municipal water supply. This ERA is expected to be completed in 1988.

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2.2 SITE DESCRIPTION

2.2.1 Topography, Surface Water, and Drainage

The site borders Tulpehocken Creek (see Figure 2-2), approximately 37 miles upstream of the confluence with the Schuylkill River and about 16 miles upstream of Blue Marsh Lake. Myerstown is the first downstream community, at a distance of approximately 3/4th of a mile.

The headwaters of the section of Tulpehocken Creek which passes by the site originate approximately 3 miles to the northwest. The creek is formed by springs and runoff from Blue Mountain.

The Tulpehocken Creek drainage basin covers 211 square miles and is 33.5 miles long, with an average bed gradient of 0.0015 ft/ft. The average annual creek flow at the Blue Marsh damsite was calculated at 253 cubic feet/second (cfs), with the maximum flood flow being 16,100 cfs on June 22, 1972, and the minimum flow being 22 cfs on September 12, 1966. The general direction of stream flow near the site follows the east-northeast strike of the carbonate bedrock.

Creek flow at the site is supplemented by pumping from the large active limestone quarry west of the site. When the quarry was being pumped in the early 1980s, the quarry discharge accounted for about three-quarters of Tulpehocken Creek's baseflow at the site.

The quarry's new ownership has allowed the quarry to partially fill. The quarry water level (and pumping rate) is now dependent on what portion of the quarry needs to be accessed for ongoing operations.

Tulpehocken Creek is used extensively for recreation and fishing within 3 miles of the site. Above the site the creek supports a native brown trout fishery. At the site and downstream, white suckers and some carp survive year-round. Additionally, this stretch of creek is stocked with legal-sized trout three times a year. The trout and possibly the carp and suckers are consumed by humans.

There is a possibility that some of the planted trout survive through the fishing season by living next to cold springs. However, this possibility is considered low, due to the warmth of the stream water at and below the site.

Approximately 7 miles downstream of the site, Tulpehocken Creek is impounded by the Charming Forge Dam. The lake behind the dam has filled with sediments to a point where the creek is flowing directly over the crest of the dam. Charming Forge Lake is actively fished for bullhead and carp. Some of these fish are believed to be consumed.

300121

Blue Marsh Lake, a warmwater lake, supports an active bass and panfish fishery. These fish are likely consumed.

The tailwater section of Blue Marsh Dam supports an active trout fishery. Trout fishing along this creek stretch has received national attention.

There are several ponds and quarries in and around Myerstown which are fed by groundwater. Included in this list are the Myerstown Pond, a 2-acre community lake 1 mile east of the site, the Lakeside Quarry on the east end of Myerstown, 2 miles east of the site, two smaller quarries on the Wenger property near Race Street in Myerstown, about 1/4 mile northeast of the site, and a quarry west of the Kreider property, 1/2 mile west of the site. Catfish, bluegills, and bass are probably present in the Myerstown Pond. Lakeside Quarry is stocked with fingerling trout by the Pennsylvania Fish Commission. The two Wenger quarries, which are private, have bass and panfish in them. The same situation is probably true for the quarry west of the Kreider property.

2.2.2 Geology and Hydrogeology

2.2.2.1 Geology

The Whitmoyer Laboratories Site is located within the Lebanon Valley, part of the Great Valley portion of the Valley and Ridge Physiographic Province. The valley is a topographic expression of the underlying relatively easily eroded carbonate bedrock units. The site is underlain by carbonate bedrock of the Ontelaunee Formation, the youngest member of the Ordovician Age Beekmantown Group. A thin mantle of clayey residual soil overlies bedrock in the site vicinity. Depths to bedrock in the site vicinity are expected to range from 0-18 feet, based on available boring logs. The depth to bedrock is expected to be greatest in the vicinity of Tulpehocken Creek and the Union Canal.

The Ontelaunee Formation is described in regional literature as a light to dark gray dolomite, which weathers to a dark grayish brown (Meisler, 1963). Regular parallel banding is characteristic of this formation, as is the presence of stylolites. The Ontelaunee Formation strikes N60°E to N80°E predominantly, with an overall dip to the SE of approximately 30°. In the Myerstown area, this formation is approximately 500 feet thick.

Approximately 1,500 feet north of the site area, the Annville and Myerstown Limestones outcrop along a narrow east-northeast trending band. These units, which underlie much of the town of Myerstown, physically underlie the Ontelaunee Formation but are stratigraphically younger. The reversed position of these beds with respect to the Ontelaunee Formation is an indication that the bedrock units in the site area represent the overturned (older beds overlie younger beds) south limb of a recumbent

300122

synclinorium (Meisler, 1963). The Annville Limestone is described as a thick-bedded, light blue to pink-gray, crystalline, high-calcium limestone, with gray mottling and banding at the base. The unit weathers to white in outcrops. In the Myerstown area, the Annville Limestone is about 250 feet thick and is extensively quarried. The Myerstown Limestone stratigraphically overlies and physically underlies the Annville Limestone (the bedding is overturned). Regional literature describes the Myerstown Limestone as a dark-gray, crystalline limestone which becomes shaley near the base of the unit. The Myerstown Formation is approximately 250 feet thick, and is separated from the Annville Formation by a 2- to 6-inch-thick seam of iron-stained clay.

Further north, the Hershey Formation outcrops. This unit is described as a dark-gray, argillaceous limestone approximately 450 feet thick. The town of Myerstown is reported to obtain its municipal groundwater supplies from this formation.

A few hundred feet south of the Whitmoyer Laboratories Site, the Epler Formation outcrops. This unit, part of the Beekmantown Group (along with the Ontelaunee Formation), has a variable lithology, including limestone, dolomite, and chert. The Epler Formation is stratigraphically older but physically overlies the Ontelaunee Formation, and is approximately 1,000 feet thick in the local area.

Structurally, as described previously, the rock units in the area represent the south limb of an overturned syncline. All of the units strike to the ENE and dip to the southeast at an approximate 30-degree angle. Jointing, as measured in outcrops, shows two preferred orientations. One joint set strikes N50-70°E, while the other set strikes N15-35°W. Both sets of joints are predominantly steeply dipping to vertical. A fracture trace analysis performed for the Lebanon Valley showed lineaments have a preferred trend of N45-65°E, which parallels one of the major joint sets identified. No significant trend of lineaments was identified in association with the other major joint set measured.

Stream channels in the area tend to show linear segments oriented parallel to the predominant joint orientations and bedrock strike, and thus are somewhat structurally controlled.

Both strike-slip faulting and thrust faulting has been identified in the Myerstown area. An inferred northwest trending strike-slip fault is located approximately 3,500 feet east of the site. The fault is approximately 2.3 miles long, has an estimated 800-foot displacement, and crosses Tulpehocken Creek. The nearest thrust fault is an east-northeast striking, southeast dipping fault located adjacent to and parallel to a limestone quarry located 4,000 feet west of the site. Several other faults are located within 3 miles of the site. Springs are often associated with these faults (Meisler, 1963).

300123

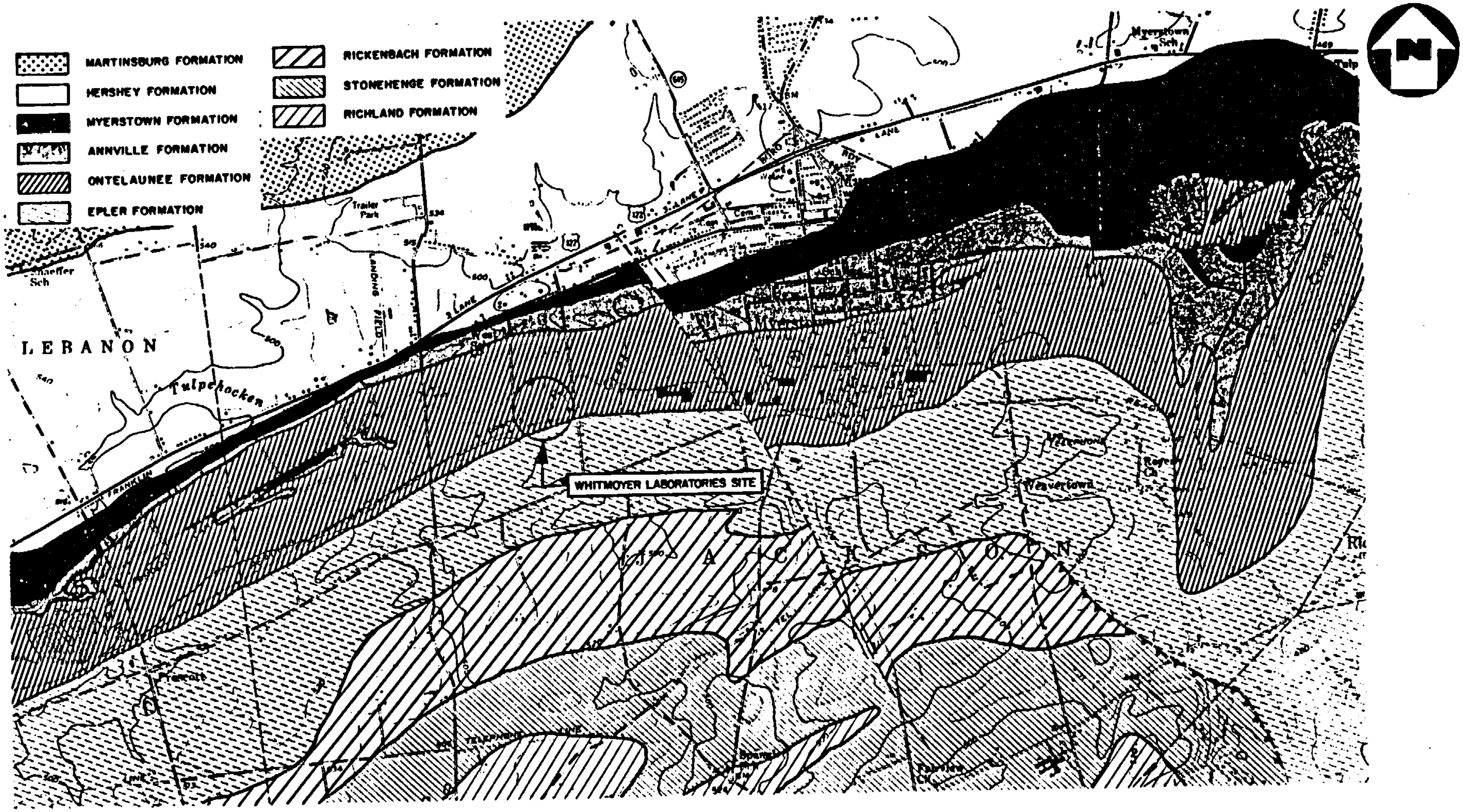
Soils in the area are primarily residual soils derived from weathering of the bedrock surface, with some alluvium adjacent to Tulpehocken Creek. Based on available boring logs for the area, the soils consist predominantly of silt and clay. A thin veneer of organic-rich topsoil overlies the residual soils throughout much of the area. Near the stream, somewhat coarser-grained alluvial deposits may be found.

2.2.2.2 Hydrogeology

The carbonate bedrock units underlying the Lebanon Valley form the major aquifer in the area. The various formations present, although differing somewhat in water-yielding capacity, are considered to form a single, large, heterogeneous, unconfined aquifer. The porosity of the carbonate aquifer is almost entirely secondary, with fractures enlarged through solution channeling forming the primary groundwater storage zones and migration pathways.

Of the formations present in the local area surrounding the site, the Ontelaunee Formation, which underlies the site, is considered to be the highest yielding unit on an overall basis (see Figure 2-3). The Hershey and Epler Formations are regarded as relatively low-yielding formations, while the overall yields of the Annville and Myerstown Formations cannot be categorized due to a lack of well data for these units. One-half of all wells completed in the carbonate bedrock units of the Lebanon Valley have specific capacities of 5.2 gallons per minute per foot of drawdown (gpm/ft dd) or less (Meisler, 1963), which roughly corresponds to a transmissivity of 8,000 gallons per day per foot (gpd/ft) or less. This data includes both wells installed in the formations surrounding the site and wells in other carbonate bedrock units in the area, and thus may be significantly different from local conditions in the site area. According to domestic well logs, the principal water-bearing zone within the carbonate rocks occurs from 70-80 feet below ground surface. Twenty-five percent of all water-bearing zones (fractures) encountered were found at depths of less than 62 feet, another 25 percent were found within the depth interval 62-80 feet, 25 percent of all water-bearing zones were found at depths ranging from 80-145 feet, 15 percent were found at depths ranging from 145-230 feet, with the remaining 10 percent encountered at depths exceeding 230 feet (Meisler, 1963). Boring logs from site-related monitoring wells indicate that most fractures encountered were found at depths of 35 feet or less, with possible secondary groupings of fractures in depth ranges of 50-60 and 75-100 feet.

Groundwater flow directions in the area generally follow topography, then follow stream flow direction in valley bottoms. In the site area, groundwater is expected to flow to the northeast towards Tulpehocken Creek and the Union Canal, then generally follow the course of the stream to the east-northeast.



SOURCE: MEISLER, 1963.

300125

FIGURE 2-3

BEDROCK GEOLOGY
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

NUS CORPORATION

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Groundwater pumping in the limestone quarry west of the site distorts the regional flow gradient significantly, as the quarry acts as a groundwater sink and discharge point for a significant area surrounding the quarry (the quarry discharges pumped water to Tulpehocken Creek). This pumping creates a westward gradient and westward movement of groundwater in the area immediately to the west of the site, contrary to the regional east-northeast flow direction. It is not currently known whether the influence of quarry pumping extends eastward as far as the site. Recent mapping of groundwater levels in Lebanon County indicates that the cone of depression related to quarry pumping may be affecting groundwater levels at the site to an undetermined degree (Royer, 1983).

Recharge to groundwater in the carbonate rock units is principally through precipitation infiltration, with additional recharge due to groundwater migration from adjacent rock units and occasional surface water recharge, during extended dry periods. Geochemically, groundwater is of the calcium-bicarbonate type, and is typically hard.

2.2.3 Climatology

The Whitmoyer Laboratories Site is located within the southeastern Piedmont Climatological Division of Pennsylvania. Second Mountain, which rises 1,500 feet along the north border, and South Mountain, which rises 1,000 feet along the southern border, form the Lebanon Valley, in which the site is located. The Lebanon Valley has a humid continental climate. Due to the valley's location, weather systems are typically modified before reaching Lebanon County. Weather extremes are most often the result of unusually strong weather systems.

The average annual precipitation at the site is 42.3 inches; this precipitation is mostly evenly distributed throughout the year, with slightly less precipitation occurring in the winter. The average annual snowfall is 27 inches. Evaporation at the site is 36.3 inches; thus, net precipitation is 6 inches.

In the summer, high temperatures are generally in the mid-80s and the lows near 60°F. During the winter the highs average in the upper 30s and the lows in the 20s. The prevailing wind is from the northwest in winter and from the west-southwest in summer.

2.2.4 Population and Environmental Resources

Lebanon County, according to the 1980 census, has a population of 109,829, and is classified by the Commonwealth of Pennsylvania as a "5th class" county. The population of Myerstown in 1984 was 3,270. Populations of 1,296 and 4,683 reside within 1 and 3 miles of the site, respectively.

Portions of Tulpehocken Creek contain open water wetlands areas consisting of the riverine system of the creek and Union Canal.

The area has some habitat value, with opossum, raccoon, numerous fish, a water snake, and various passerine songbirds observed during a 1986 USEPA site visit.

Tulpehocken Creek has been proposed for inclusion on the Commonwealth of Pennsylvania's scenic river system, with a "priority 1A status." This designation is for streams which "have the most urgent need for protection and immediate need for additional study," according to a PADER official. This designation is currently in the public hearing process.

2.2.5 Nature and Extent of Problem

2.2.5.1 Vault

As reported above, a concrete vault measuring 123 feet long by 83 feet wide and 12 feet deep was constructed to permanently store the lagoon sludges and other contaminated material which were excavated during the 1965 cleanup (see Figure 2-2). The walls are reportedly 8 inches thick and were coated with a bitumastic sealant. This reported thickness has not been verified. Two inches of sand and four approximately 3-inch diameter draw tubes (extraction pipes) were installed in the vault to collect and remove residual liquids from the emplaced wastes (see Figure 2-4).

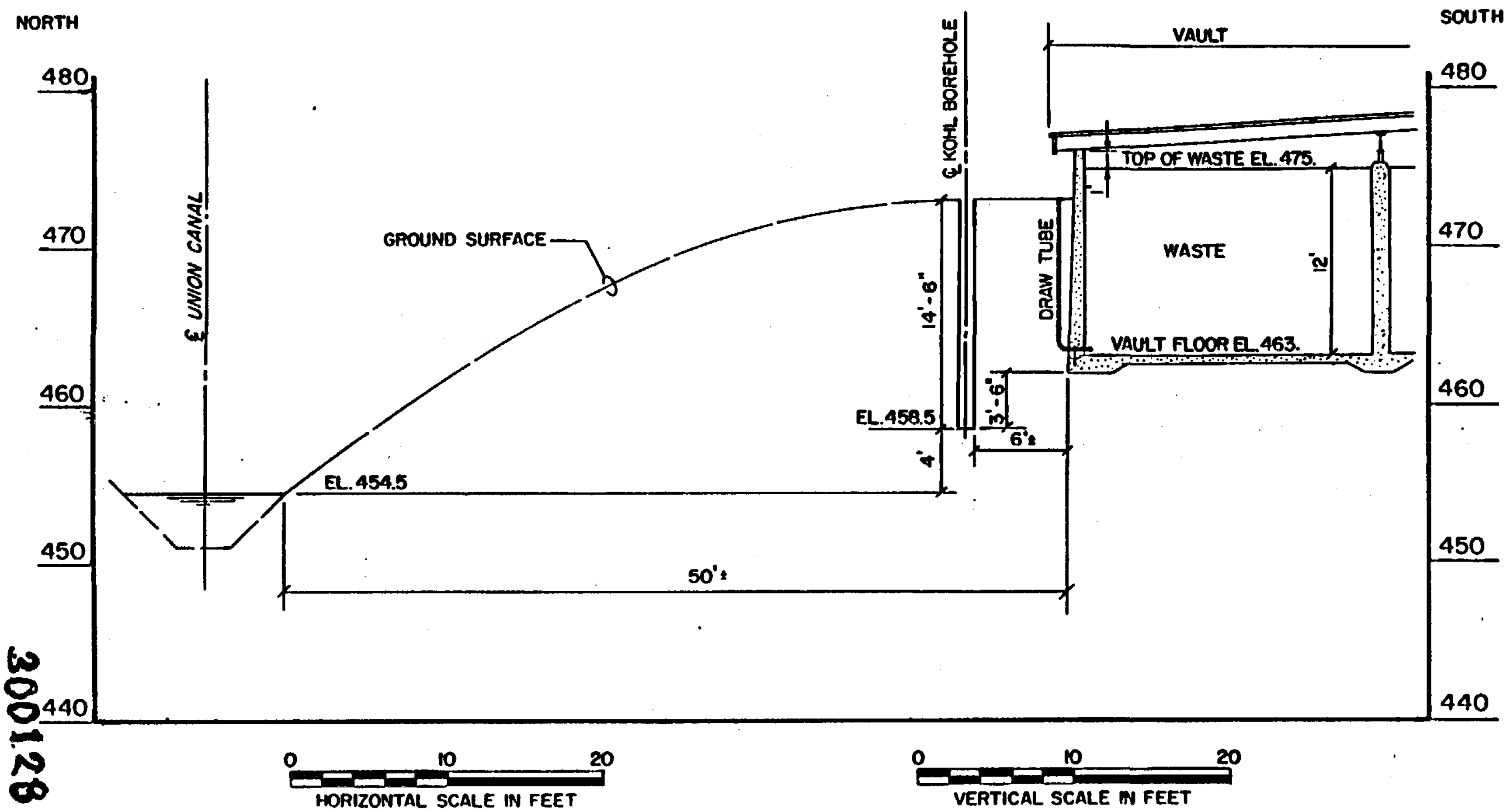
Available records indicate that lagoon sludges containing 3,660,000 pounds of arsenic and 250 drums of soil underlying the DDAA storage piles containing 12,000 pounds of arsenic were placed in the vault during this cleanup. Reportedly 1,455 drums containing aniline still bottoms were also placed in the vault.

Additionally, when the plant was restarted in the spring of 1965, R&H reported to PADER that spent filter paper and carbon filter cake from the arsanilic clarification operations and fiber drums containing aniline still bottoms were to be placed in the vault. An analysis of the aniline still bottoms showed they contain 12-13 percent arsenic, 30-40 percent aniline, and 25-35 percent triamino triphenyl arsonic acid (TTAA). In 1982, material resembling tar (which was found in a fiber drum) and charcoal-like powder were observed and sampled by WLI. This observation supports the 1965 report to PADER.

Finally, at least 2-1/2 drums of "shell" deposit from the groundwater treatment mixing tanks were also placed in the vault. In all, an estimated 3.75-4.0 million pounds of arsenic were placed in the vault.

A 1966 WLI memo indicated that water containing elevated arsenic levels from an unspecified "pit" was pumped to the vault. The time span of this practice was not specified.

300127



SOURCE: WLI FILES

FIGURE 2-4

CROSS SECTION OF VAULT, KOHL BOREHOLE, AND UNION CANAL
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

NUS CORPORATION

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Water levels in the vault were measured periodically from 1979 through 1983 using the vault draw tubes. The water level in the northwest draw tube (No. 4) fluctuated as much as 2.75 feet in one month (August, 1982), and fluctuated 19 inches or more during four different periods, indicating that the northwest corner of the vault is either open to the environment or is connected with the aquifer (and possibly Tulpehocken Creek). The remaining draw tubes' water levels fluctuated over a range of 8 inches from 1981 to 1983.

During the January 1988 site visits, the tops of three of the four draw tubes were open to the atmosphere. It is extremely unlikely, however, that precipitation entering the draw tubes could have caused the fluctuation in the northwest draw tube. Numerous cracks were also observed in the vault's concrete walls.

The vault solids have been sampled twice, in 1982 by WLI and in 1987 by the USEPA TAT (see Table 2-1). The arsenic concentration of the solids measured by WLI ranged from 44,000 (4.4 percent) to 750,000 mg/kg (75 percent). The lower quantity was described as soil-like with stones. Additionally, elevated levels of aniline were detected by WLI.

The USEPA TAT also detected 4.4 percent arsenic in their sample. TAT conducted an EP toxicity test for arsenic on their sample. The EP extract assayed 2,100 mg/l arsenic. Approximately 95 percent of the arsenic in the sample was taken into solution under the EP toxicity test conditions. As a point of comparison, the USEPA presently considers any waste having an EP extract greater than 5 mg/l to be "hazardous."

Additionally, eleven sampling events were identified during which liquid samples were collected from the vault. With the exception of a July 10, 1981, apparent outlier, the liquid arsenic concentrations ranged from 1,375 mg/l to 30,420 mg/l, with an average of 7,200 mg/l. This data is contained in Table 2-2.

In 1979 WLI drilled a borehole (the Kohl Brothers borehole) in between the vault and the nearby Union Canal (see Figure 2-4). The groundwater from the borehole was sampled 21 times since then, including the February 17, 1984, sampling by the USEPA TAT team. These data are contained in Table 2-3. The borehole liquid arsenic concentration averaged 103 mg/l. The USEPA 1984 result was 6.6 mg/l arsenic.

The USEPA TAT also sampled the borehole liquid and sediment for aniline, volatile organics, and phenols. The sample results are contained in Table 2-4. Trans-1,2-dichloroethene, methylene chloride, PCE, TCE, and phenols were detected in the borehole liquid, while methylene chloride, ethylbenzene, toluene, and phenols were detected in the borehole sediment.

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TABLE 2-1

CONCENTRATIONS OF ARSENIC IN VAULT SOLIDS
WHITMOYER LABORATORIES SITE
(mg/kg unless otherwise indicated)

Date	10/6/82	10/6/82	10/6/82	10/6/82	7/10/87
Sample Location	NW Vent	NE Vent	SW Vent	SE Vent	Roof Vent
Sampler	WLI	WLI	WLI	WLI	EPA
Total Arsenic	140,000	750,000	173,000	44,000	44,000
Inorganic Arsenic	69,000	5,200	167,000	7,900	NA
EP Toxicity Arsenic (mg/l)	NA	NA	NA	NA	2,100
Total Cyanide	4	325	0.2	3	NA
Aniline	140,000	<50	6,500	50	NA
Total Sulfide	100	<30	<60	<30	NA
Barium	<.003	335	0.225	135	NA
Cadmium	3.06	1.20	1.53	1.64	NA
Chromium	5.40	3.21	8.94	28.63	NA
Lead	7.37	36.86	33.18	112.43	NA
Mercury	0.20	1.43	<1	0.18	NA
Selenium	14.5	7.6	13.9	19.5	NA
Density (#/cf)	70	103.4	18.4	65.8	NA
Appearance	Tar resemblance-sampled from a fiber drum	Powder-like peach color	Charcoal-like powder	Soil-like texture with stones	

NA = Not Analyzed

TABLE 2-2

AVERAGE CONCENTRATIONS OF ARSENIC IN
VAULT WATER
WHITMOYER LABORATORIES SITE
(All Data in mg/l)

Date	Number of Samples	Total Arsenic Concentrations
05/31/65	1	5,000.0
10/25/65	1	7,770.0
09/04/77	1	30,420
01/08/78	4	6,675
12/11/78	4	6,569
03/22/79	4	1,375
03/29/79	4	2,925
05/08/79	4	2,575
03/18/81	2	6,200
07/10/81(1)	1	0.002
08/13/82	3	2,259

(1) Appears to be an outlier

300131

TABLE 2-3

GROUNDWATER CONCENTRATIONS
OF ARSENIC (mg/l) IN
KOHL BROTHERS (VAULT) BOREHOLE
WHITMOYER LABORATORIES SITE

Date	Sampler	Total Arsenic Concentrations
04/22/79	WLI	0.28
05/07/79	WLI	0.50
05/22/79	WLI	3.50
05/29/79	WLI	5.06
06/12/79	WLI	6.40
07/16/79	WLI	66.40
08/20/79	WLI	89.0
09/25/79	WLI	23.2
10/23/79	WLI	51.8
11/28/79	WLI	91.50
12/28/79	WLI	71.5
01/31/80	WLI	166.5
03/27/80	WLI	80.50
04/30/80	WLI	157.5
05/28/80	WLI	960.0
06/13/80	WLI	28.0
06/30/80	WLI	64.5
10/31/80	WLI	113.5
11/26/80	WLI	173.5
02/05/82	WLI	2.88
02/17/84	EPA	6.60

TABLE 2-4

CONCENTRATIONS OF ORGANIC CONTAMINANTS IN
GROUNDWATER AND SEDIMENT
AT KOHL BROTHERS (VAULT) BOREHOLE
WHITMOYER LABORATORIES SITE

	February 17, 1984 TAT Sampling	
	Water (µg/l)	Sediment (µg/kg)
Aniline	<10	<.4
Benzene	ND	ND
Chlorobenzene	ND	ND
Chloroform	ND	ND
1,1-dichloroethene	ND	ND
Trans-1,2-dichloroethene	360	ND
Ethylbenzene	ND	200
Methylene Chloride	700	7,900
Perchloroethylene	900	ND
Toluene	ND	2,900
Trichloroethylene	370	ND
Phenols	60	4700
Arsenic	6,600	264,000

ND = Not detected

300133

In February 1988 the USEPA TAT hand-augered four holes near the vault to a depth of approximately 8 feet. Samples were composited over the entire hole length and analyzed for arsenic. The first and second holes, located approximately 50 feet south of the southeast and southwest corners of the vault, assayed 160 mg/kg arsenic and 93 mg/kg arsenic, respectively. The third and fourth holes, drilled about 11 feet north of the northeast and northwest corners of the vault, contained 1,500 mg/kg and 2,200 mg/kg As, respectively. The holes to the north of the vault are apparently downgradient of the vault.

2.2.5.2 Lagoons

Arsenic Sludges

Historic aerial photos from the site indicate that the dike around the easternmost oil tank was the first lagoon to be used at the site. Arsenic wastewaters were originally precipitated in this unlined lagoon from approximately 1957 to 1964, as described above. This lagoon was later cleaned, compartmentalized, and refurbished to receive waters from the groundwater pump and treat program.

The lagoons are apparently numbered according to the order in which they were brought on-line to receive treated groundwater during the 1964-1965 cleanup. New western lagoons 1 through 4 were the first to be brought on-line. It is believed these lagoons had topsoil liners. Following completion of lagoons 1 through 4, the original eastern lagoon had its calcium arsenate sludge placed in the vault and was then refurbished into lagoons 5 through 12. Finally, new western lagoons 13 through 15 were added (see Figure 2-5).

Of the new lagoons, lagoons 1 through 3 and 13 through 15 used the dike constructed around the western oil storage tank. Lagoon 4 was apparently created from an emergency overflow pit which had been originally excavated along the site's western boundary.

It is unclear what most of the lagoons were lined with. There are mixed reports about the lining material. In the original 1965 weekly cleanup reports, it stated that lagoons 4 and 5, which were constructed immediately before lagoons 6 through 12 were refurbished, had topsoil liners. The last lagoons constructed, lagoons 13 through 15, had 6- to 8-inch clay liners installed. These same documents imply that lagoons 6 through 12 also had topsoil liners. In a 1973 memorandum, it stated lagoon 4 had one of the highest percolation rates, while lagoon 15 had one of the slowest percolation rates. This supports the 1965 reports. In the same memorandum, however, it was stated that all of the lagoons had 6- to 8-inch clay liners. A 1976 memo also reported that lagoon 7, one of the refurbished lagoons, had a clay layer. The lagoons have earthen walls and rest directly on bedrock.

300134

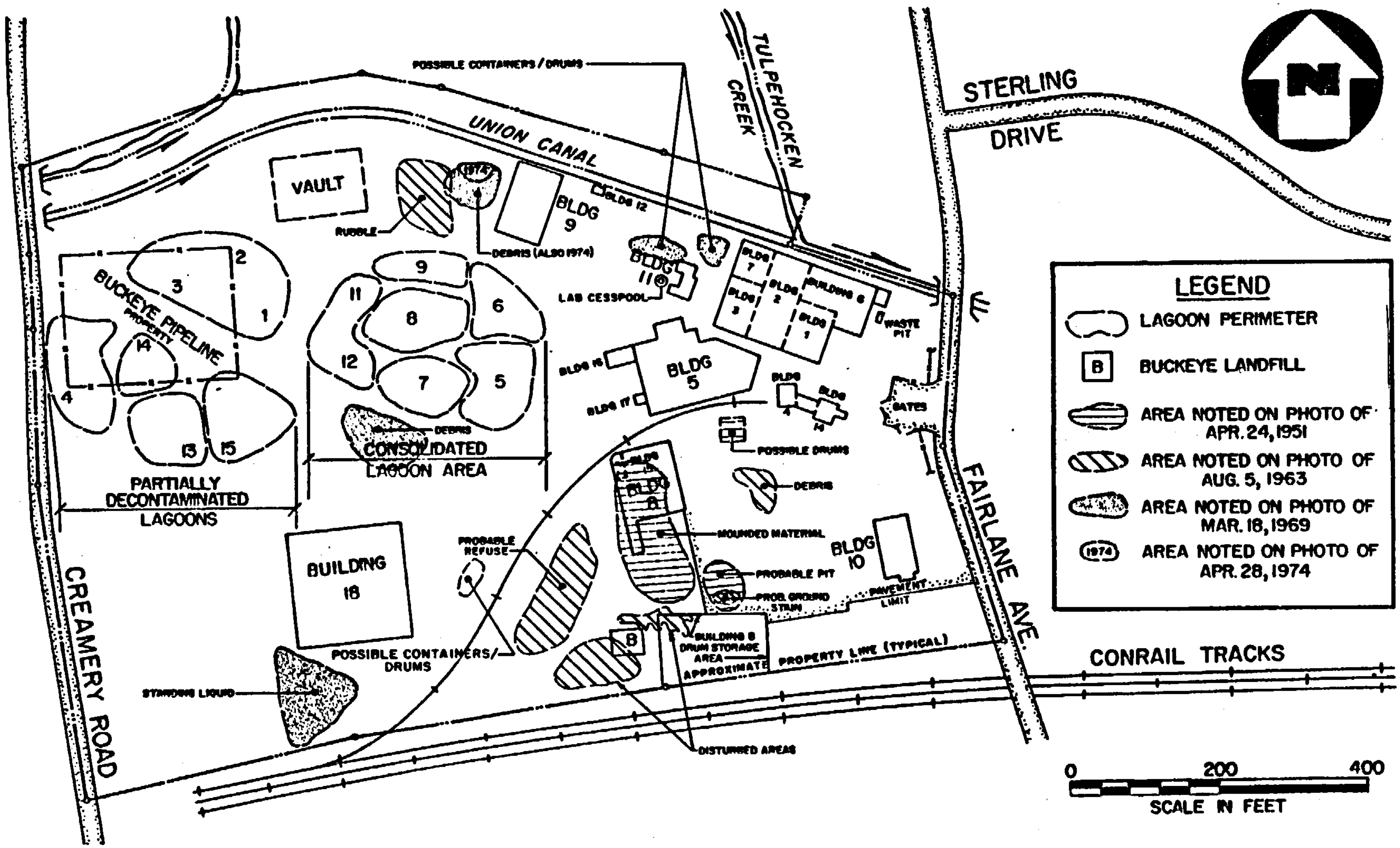

FIGURE 2-5

APPROXIMATE LOCATION OF POTENTIAL SOURCE AREAS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

NUS CORPORATION

300135

When the groundwater pump and treat program was completed, the lagoons reportedly contained 3,480 tons of ferric arsenate sludge containing approximately 197 tons (394,000 pounds) of arsenic. These figures give an average sludge arsenic content of 5.67 percent (56,700 mg/kg As). The lagoons covered approximately 2.5 acres.

In late 1976 and 1977, R&H consolidated the lagoon sludges. When the lagoons were consolidated, lagoons 1 through 4 and 13 through 15 were excavated and the sludge added to the existing sludge in lagoons 5 through 12. Some sludge seeped into bedrock fractures in the bottoms of the abandoned lagoons. This sludge was left in place. To restrict further movement of the remaining material, R&H placed a 1/4- to 1/2-inch thick layer of bentonite over the excavated lagoons. The bentonite was wetted and covered with 1.5 to 2 feet of earth. Following this, the cover was revegetated.

The contractor performing the sludge consolidation had problems with his equipment sinking into the sludge. To increase the sludge's bearing capacity, fractured bedrock underlying the western lagoons and dike material from these lagoons was added to the consolidated sludge to provide additional support.

The additional sludge (and admixed rocks and dirt) raised the elevation of the sludge material in the consolidated lagoons from 5 to 8 feet. At the time, R&H was considering capping the consolidated lagoons with hypalon, clay, or macadam. The records do not indicate the cover material selected. The consolidated lagoons are well-vegetated. Therefore, they were probably capped with at least topsoil.

In July 1987, the TAT conducted ground-penetrating radar (GPR) and magnetometer surveys of the lagoon areas to determine the lagoons' volumetric extent and if buried drums were present in the lagoons. The magnetometer survey identified a probable buried pipe in the northeast corner of the lagoons and a possible small buried drum area in the southeast corner of the lagoons. The TAT reported that if drums were present, their quantity was most likely less than 10.

Liquid Wastes

Several reports of liquid wastes being dumped into the consolidated lagoons exist. In 1965 it was reported that oil from the oil receiver and process waste solutions from the production of coal tar dip and piperazine were pumped out to the lagoons for disposal. Also in 1965 it was reported that wash water from the truck wash bay was deposited in lagoon 6. This practice continued through at least February 1976.

The WLI plant had problems with groundwater infiltrating into the basements of Buildings 3 and 11. Beginning in April 1975, water pumped from these basements was also routed to lagoon 6. This practice continued until mid-1975. In 1976 this water was again routed to the lagoons for a 2-month period, according to company reports. The termination date of this practice, if any, is undetermined.

In 1982 an internal WLI memo indicated that wastewaters from cleaning hazardous waste transport trucks were pumped to the lagoon area and permitted to percolate into the ground.

Chemical Analyses

As stated above, R&H believed that the ferric arsenate sludges contained approximately 5.67 percent arsenic. In 1971 R&H took a grab sample from the sludge. It contained 4.6 percent total arsenic, which included 2.93 percent inorganic arsenic. In a 1975 WLI memo, it was reported that the "clay" floor of lagoon 7 contained 3.1 percent (31,000 mg/kg) total arsenic.

The USEPA TAT sampled the lagoons with five auger holes in 1987 (see Table 2-5). The 0-3 foot interval had an average arsenic content of 7,120 mg/kg, while the 3- to 6-foot interval had an average content of 14,200 mg/kg. The EP extracts for these intervals averaged 6.42 mg/l arsenic. Judging from the analytical results, these samples included admixed soil and rocks. (Note: ferric arsenate with a iron/arsenic ratio of 2:1 is less soluble by approximately two orders of magnitude at a pH of 5 when compared to a pH of 7.)

WLI attempted to estimate the leachate generation potential of the ferric arsenate sludge several times during the plant operations. In 1965 WLI placed a horizontal sample pipe into lagoon 4 during its construction. Two water analyses conducted then averaged 2.65 mg/l As.

Field solubility tests apparently were conducted in 1965 and 1969. The protocols for these tests were unspecified, but it is believed that rainwater was allowed to percolate through the sludge, followed by collection for analysis. The leachate arsenic content ranged from 0.03 mg/l to 5 mg/l during this period.

In 1971, when R&H collected its grab sample, it filtered the sample and analyzed the filtrate. The filtrate contained 24 mg/l arsenic. In 1972 R&H attempted to estimate the leachate generation potential of the sludge by adding 50 grams of sludge to 100 ml of deionized water and agitating the slurry, followed by filtration and filtrate analysis. The residual solids were then added to fresh deionized water and the process repeated until six extractions had occurred. Sludge from lagoons 4, 5, 11, and 13 was utilized for these tests. The filtrate averaged 1.25 mg/l As for these tests, with the range being from 0.42 mg/l to 2.99 mg/l As. The filtrate values remained relatively constant and did not show a definite trend through the six extractions.

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TABLE 2-5

JULY 9, 1987 USEPA TAT SAMPLE RESULTS
LAGOON ARSENIC SAMPLES
WHITMOYER LABORATORIES SITE

Depth/ Analysis	Sample Location					Average
	1	2	3	4	5	
0-3'-Total Arsenic	5,000 mg/kg	18,000 mg/kg	2,600 mg/kg	5,200 mg/kg	4,800 mg/kg	7,120 mg/kg
0-3'-EP TOX	3.8 mg/l	2.6 mg/l	10 mg/l	2 mg/l	11 mg/l	5.88 mg/l
3-6'-Total Arsenic	20,000 mg/kg	28,400 mg/kg	2,000 mg/kg	12,800 mg/kg	7,600 mg/kg	14,160 mg/kg
3-6' EP TOX	4.3 mg/l	4.3 mg/l	8.4 mg/l	9.4 mg/l	8.4 mg/l	6.96 mg/l

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In 1973 column leaching tests using the Chem-Fix Leaching Test Procedure were initiated. While the test protocol was not specifically identified, it is believed that the test basically involved placing the sludge in columns and trickling deionized water through the columns until 10 pore volumes had passed through. Each pore volume was analyzed separately. A sludge sample from each lagoon was taken and subjected to this test. The column leachate averaged 12 mg/l As, with the range of each sludge's average leachate value being from 0.48 mg/l to 79.5 mg/l As. The lagoons whose sludges had the lowest leachate values during the column tests were lagoons 4, 5, and 13. These lagoons were three of the four used for the 1972 agitated tests. Therefore, the 1972 agitated test values are probably biased low.

As an additional effort, three pipes were driven into the lagoon sludges to collect pore water samples. Two of the pipes were driven into lagoon 5, while the other was driven into lagoon 7. Pore water arsenic analyses ranged from 0.62 mg/l to 342 mg/l As. It was theorized that the high values were attributable to residual calcium arsenic sludge left in the lagoon during cleanup. However, an analysis of the suspected calcium arsenate sludge only assayed at 1,750 mg/kg As.

Finally, four perimeter wells around the lagoons were sampled twice in 1975. The average groundwater arsenic values ranged from 3.37 mg/l for the southwestern well to 45.3 mg/l for the eastern well. Groundwater-level measurements indicated that groundwater flow was from southwest to northeast during this period.

Aniline was also measured once from these three wells. All of the assays were less than 10 mg/l aniline.

2.2.5.3 Process Buildings

There are 17 buildings (1 through 12 and 14 through 18) located at the WLI facility (see Figure 2-2). The buildings appear to be numbered in the order in which they were constructed, e.g., Building 1 is probably the oldest. Each of these buildings will be discussed below. Since building entry was not feasible during the site visits due to health and safety concerns and details on the current state of the buildings are not present in the available files, the buildings cannot be described in detail here.

Company reports indicated that Building 1, a two-story building, was used for the manufacture of PIK-REM (a coal tar-based product), CRESANOL (coal tar dip), and unidentified liniments and ointments. The building's exterior walls are brick, the interior wall appears to be brick, the first floor is made of concrete (with some large cracks visible), and the second floor flooring material is wood. A strong organic vapor was detectable in Building 1 when the door was opened during a January 29, 1988, site visit.

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Building 2 is also a two-story, bricked-exterior structure. Building 2 was the site of the liquid blending department where Laro, a phenol-based compound, Whitsyn-S, a compound with pyrimethamine and sulfaquinoxaline as its active ingredients, and coal tar- (cresylic acid) based compounds were reportedly manufactured. Additionally, piperazine and sulfa compounds were manufactured there at one point. The second floor of Building 2 contained the waste evaporation unit for the plant. Finally, an ion exchange unit using caustic and muriatic acid was present there. During the January 29, 1988, site visit, approximately 100 large cardboard boxes containing laboratory chemicals were observed on the floor of the first level of Building 2.

Building 3 is also a two-story, bricked-exterior structure. This building was once the site of the shipping department. The building's present condition is unknown.

The basement of Building 3 was sufficiently deep to have a problem with groundwater infiltration. This water was disposed down well 4, on the lagoons, or through standard plant wastewater handling procedures. This basement may have been filled in.

Building 4, once known as the coal shed, is a two-story, concrete-block-exterior building. This building contained a boiler for steam generation. Judging from its former name, coal may have been the original boiler fuel. Since the 1960s fuel oil has been used for steam generation.

Building 4 was also once the site of piperazine production. Company reports also indicated that they were considering reprocessing DDAA in this building. It was not determined whether this was the actual site for reprocessing.

Building 5 is a three-story bricked exterior building with an attached grain silo. The building was used to prepare feed pellets and fish oil formulations. Arsanilics were added to feed pellets in this building. Additionally, zinc and copper were added as trace minerals. Methyl bromide was used as a fumigant here. Finally, reportedly cresylic acid was used in this building. Parts of Building 5 were also used for storing WLI products.

Building 6 was the site of arsanilic production. Chemicals used in this production include arsenic, aniline, PCE, para-chloroaniline, muriatic acid, and sodium cyanate. Floor drains from this building led to the Department 8101 waste pit (see below).

Not much is known about Building 7. The building is a two-story, cinder-block structure. The cooling tower is present on the building's roof. Two larger blowdown tanks were located to the west of the building.

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Building 8 is a two-story, concrete-block structure. This building was the site of iodate, chlorhexidine digluconate, glytussin, and piperazine production. Chemicals used at this building include hydrochloric acid, muriatic acid, methanol, cellusolve (ethylene glycol monoethyl ether), mercurial salts, n-butanol, hydrazine, phosphoric acid, and ethylenediamine. Some arsenic was also used there. In addition to fixed tanks, tank trucks were used to accumulate waste methanol, cellusolve, and "non-hazardous" wastewater at this site.

A research and development laboratory was located on Building 8's south end. This laboratory contained large quantities of laboratory chemicals during the January 29, 1988, site visit.

Building 9 is the site of a one-story, concrete-block, maintenance garage. In addition to vehicle maintenance, this building served as the groundwater treatment plant site during the pump and treat program and also was used for washing out chemical tank trucks. An internal sump in the garage collected this wash water, oil, and some groundwater infiltration. These liquids were typically pumped to the lagoons.

Building 9 also reportedly had a waste pit constructed adjacent to it. This waste pit is described in more detail below.

Building 10 is the site of a two-story, concrete-block and prefabricated-facade building. This site was used as an analytical laboratory and office building. Laboratory chemicals used in quantity at this building include acetic acid, dioxane, and 1,1,1-trichloroethane.

Building 11 is a one-story, bricked-exterior building located west of Building 3. This building was the site of an analytical laboratory in the mid-1960s. Laboratory wastes were dumped into a cesspool west of the building during this period.

The laboratory also housed the women's showers and the pharmacology and parasitology laboratories. Viruses and other biologicals were used in these laboratories.

WLI also had problems with groundwater infiltration into Building 11's basement. This water was reportedly disposed down well 4, on the lagoons, or through standard plant wastewater handling procedures. The basement was reportedly filled in.

Building 12, a small, concrete-block building, served as a pump house to extract water from a small impoundment of Union Canal (the fire pond) in the event of a fire or other emergency.

Building 14 is a two-story, concrete-block structure located adjacent to Building 4. This building also contained boilers for steam generation.

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Building 15 is a one-story, concrete-block structure located adjacent to Building 8. Its use was not identified.

Buildings 16 and 17 are small, one-story, concrete-block structures located adjacent to Building 5. Their uses were not identified.

Building 18 is a large, one-story, prefabricated warehouse located in the southwestern portion of the property. The warehouse is reportedly being currently used for food storage.

To support the process operations, numerous stationary tanks and tank trucks were used for chemical storage (see Figure 2-5). Tank uses included raw chemical storage, wastewater storage, intermediate product storage, and serving as a mixing tank for the sewer effluent. Among the bulk liquids stored on site were aniline oil, arsenic acid, caustic soda, choline, chloride, cresylic acid, fish oil, fuel oil No. 2, fuel oil No. 6, isopropanol, methanol, muriatic acid, propylene glycol, and cellusolve. The current state of the bulk liquids and waste tankage is not known.

2.2.5.4 Waste Pits

Building 6 Arsenic Waste Pit

An arsenic waste pit (sump or cesspool) was constructed east of the main process buildings (Buildings 1, 2, 3, 6, and 7) prior to 1965. Early in 1965 it was discovered that this pit had been leaking approximately 300 gallons per day of process wastewater into the subsurface, and that the concrete block walls had been severely corroded. At that point, the old collection basin was reportedly excavated and a new waste collection basin (the Department 8101 Waste Pit) constructed with concrete (see Figure 2-2). Measurements taken in 1981 indicated this basin had dimensions of 7.5 feet wide by 13 feet long by 6 feet deep. The floor was 18 inches thick, while the walls were 15 inches thick.

Groundwater reportedly infiltrated into the new pit, requiring pumping. Arsenic values ranged from 177 mg/l to 669 mg/l in the summer of 1966. At the same time, the pH ranged from 8.0 to 12.3.

This basin collected process waste solutions for disposal. In its early years, wastewater was treated in the basin (to a pH of 7) prior to shipment for ocean dumping.

The Department 8101 waste pit reportedly was lined with stainless steel plate in the early 1980s. The length of time that this pit was lined was not identified.

A March 1986 report from the Lebanon Daily News stated that PADER had ordered WLI to close an underground concrete storage vault which measured about 25 by 15 feet by 7 feet deep. A

PADER spokesman stated this vault probably was used first in the mid-1960s, and had fallen out of compliance with recent regulations. The Department 8101 basin was probably the same one identified in the news article.

Organic odors from standing water in this basin were noted during both the January 6, 1988, and January 29, 1988, site visits.

Control Laboratory Cesspool (Building 11 Pit)

A 1965 report indicated that all of the analytical wastes were disposed in a cesspool west of the control laboratory building (Building 11-see Figure 2-6). About 1,000 gallons per day of solution were discharged during this period. It is not certain when this practice ended, if ever.

At least one water sample was collected from the cesspool for arsenic analysis. This sample, taken on April 1, 1965, contained 9.6 mg/l As.

On August 15, 1973, 1.49 mg/l As was found in a sample identified as "lab pit." One week later (August 22, 1973), 8.46 mg/l As was detected at the same location. It is believed that this pit is the same as the laboratory cesspool.

The laboratory cesspool was reportedly backfilled with sand and gravel at an unspecified date.

Building 9 Pit

Reportedly a cesspool was constructed on the northwest corner of Building 9 for liquids disposal. This pit was reportedly used for only a short period of time before being filled with sand and gravel.

2.2.5.5 Miscellaneous Areas

1951 Pit

In 1951 an aerial photograph of the site was taken. A probable pit (the 1951 pit) was located to the southeast of Building 8 (see Figure 2-6). This pit was located under the present site of the Building 8 drum storage area, indicating there may be contamination underlying the storage area pavement.

A former worker at the site reported encountering cardboard drums while excavating near the site of this pit. These drums may be part of the Buckeye landfill disposal area (see below), and may have contained aniline still bottoms. It is unknown whether additional buried drums are present in this area.

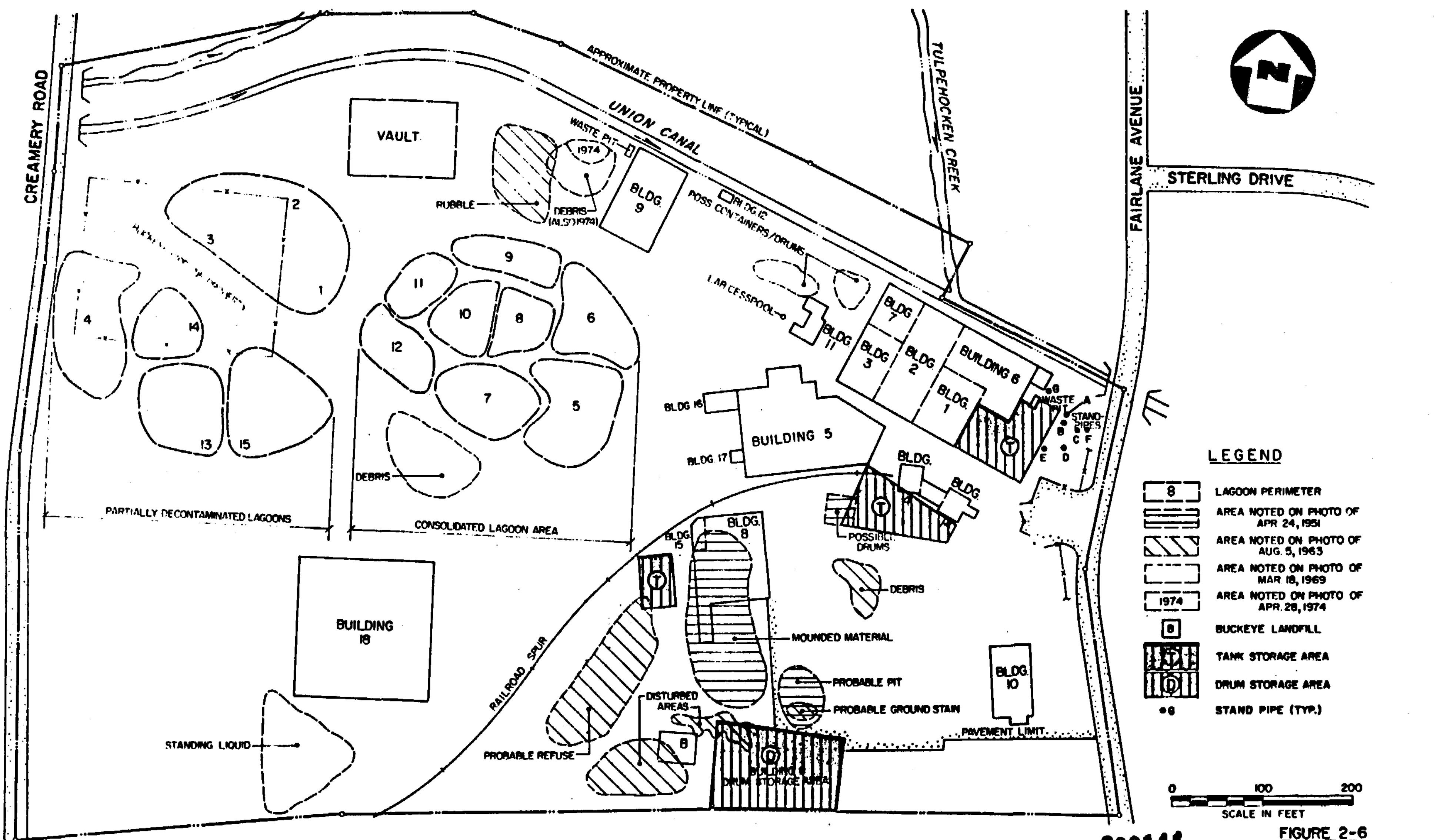

FIGURE 2-6

NUS CORPORATION

DRUM AND TANK STORAGE AREAS

WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

300144

300144

Building 8 Areas

The 1951 photograph also indicated activity in the vicinity of the future Building 8, which had not been constructed yet. Unidentified mounded material was noted on the future site of Building 8. This indicates there may possibly be contaminated material beneath the foundation of Building 8 (see Figure 2-5).

The next available aerial photo is from 1963. At this time Building 8 had been constructed. Several possible sources of contamination were identified in this photo. First, debris was present due east of Building 8 and due south of the Building 4 and 5 tank area. The probable pit identified in the 1951 photo was no longer evident, but a large probable ground stain due north of the pit area was. This stained area is now covered by a paved parking lot.

A large disturbed area was evident due south of Building 8. This area may be the calcium arsenate sludge storage area referenced in the next paragraph. The disturbed area also includes the landfill uncovered by the Buckeye excavations (see below).

Company reports from 1965 state that calcium arsenic sludge was stored south of Building 8. This sludge was reportedly excavated and placed in the vault.

A 1969 aerial photo appeared to contain an oval-shaped dome due southeast of Building 8. No reference to this "dome" was found in company reports. The area in front of Building 8 and the present-day Building 8 drum storage area had been paved between 1963 and 1969. No drums were being stored at the Building 8 drum storage area at this time. The 1969 photograph also contained indications of a possible container/drum storage area due west of Building 8 and the railroad spur (see Figure 2-5). Finally, unspecified standing liquid was evident in the southwest portion of the property due north of the junction of the railroad spur with the Reading Railroad.

A 1974 aerial photo indicated a large ground scar due west of the drum storage area. This ground scar is in the area of the Buckeye landfill (see next paragraph). The Building 8 drum storage area was nearly filled with drums and containers.

In 1979 Buckeye Oil Company repaired a section of pipeline running through the site to the south of Building 8. In the course of these repairs, underground excavations uncovered a burial ground containing old rusted metal and deteriorated fiber drums containing arsenical waste products. At that time WLI employees theorized that this area was used as a small dumping ground and was covered over around 1958 or 1959. The burial area was approximately 30 feet by 40 feet and about 7 feet deep. This area was excavated and disposed off site. Details on the excavation and removal were not identified.

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An internal WLI memo regarding the cleanup indicated that DDAA containing 0.9 percent arsenic, charcoal containing 1.2 percent total arsenic, and tar containing 8.6 percent arsenic were disposed in the landfill behind Building 8. Contaminated soil assayed at 0.3 percent (3,000 mg/kg) arsenic. It is possible that residual contamination from this cleanup remains at this site.

A 1982 internal WLI memo contained reports that wastewaters were commonly disposed on the stones in back of Building 8.

Drum Storage Areas

Aerial photography in 1951 contained indications of a drum storage area due west of the tank area south of Building 5 (see Figure 2-5). At this time this area was not paved.

In a 1969 aerial photograph, two separate possible container/drum storage areas were identified. These two areas are located north and northwest of Building 11. The two areas appear to be underlain by pavement.

The Building 8 drum storage area is discussed above. It is believed that about 400 full drums are currently present on the east side of this drum storage area.

Aerial photography in 1984 enabled identification of a drum storage area to the north of Building 18. It appears this drum area is the same as hazardous waste storage area 18A on the 1983 Prevention, Preparedness, and Contingency Plan drawing. In the photo the drum storage area was full and additional drums were stacked in a line to the east along the approach road to Building 18.

WLI memos indicated that many of the drums stored on site for final disposal were "leakers." Leaks from these drums may have contaminated soil and groundwater, creating local "hot spots." The known drum storage areas at the site are shown on Figure 2-5.

Other Debris Piles

Two other debris piles were identified in the site's available aerial photography. The first pile, located immediately west of Building 9, predates the building. This pile is evident in the 1963, 1969, and 1974 aerial photographs.

A second debris pile located across the pipeline right-of-way and immediately south of lagoon 7 was identified from the 1969 aerial photograph. No references to these piles were identified in company reports.

300146

DDAA Storage Pile Areas

In 1965, two separate scattered piles of diamino diphenyl arsonic acid, (DDAA), a waste product which was being held for later arsenic recovery, were located in the southwest corner of the property. These piles, which weighed about 2 million pounds and contained about 8.4 percent arsenic, were excavated and drummed in 1,948 drums as part of the cleanup effort. Approximately 250 drums of contaminated soil underlying the stockpiled areas were excavated and placed in the concrete vault. There is a possibility of residual arsenic remaining in the soil at the site (no data on cleanup levels were identified).

According to one former employee, this stockpile was located due south of the vault, roughly in between the two lagoon areas to the rear of Building 9. One 1965 memo indicated that DDAA was observed on the ground at the rear of Building 9, while another indicates that the DDAA was stored on top of the sludge. These memos support the former employee's report.

A second employee reported that the DDAA storage piles were west of Building 8 on both sides of the railroad tracks. A strip of probable refuse 100 to 150 feet wide paralleling the railroad spur to the east is evident in the 1963 photo.

Plant Roofs

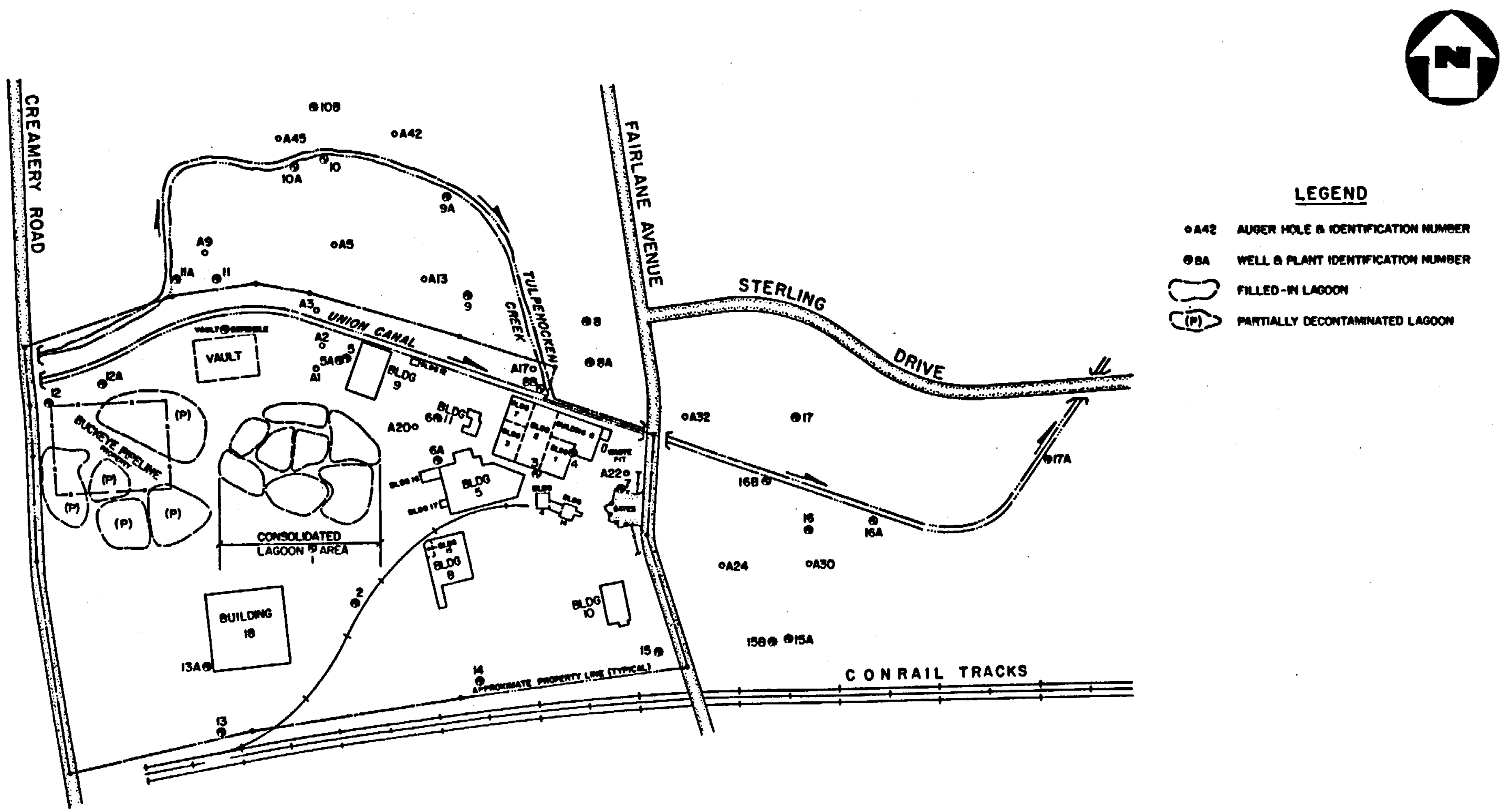
In 1976 wastewater being evaporated boiled over onto the roof of Building 7. This material entered the roof drain and ultimately ended up in Tulpehocken Creek. From this point, roof drain samples were collected periodically. Samples ranged as high as 17,000 mg/l arsenic. It is unknown whether the source of this arsenic was repeated overflows or fallout from the evaporation system stack.

Well No. 4

As stated above, the WLI plant had problems with groundwater infiltrating into the basements of Buildings 3 and 11. To dispose of this water, R&H pumped this water into well No. 4, which is more than 390 feet deep (see Figure 2-7). The quantity of water pumped into this well averaged 87,400 gallons/month during November 1975 through January 1976. The total arsenic content of the water pumped into the well averaged 40 ppm in 1975.

Discharge to the well reportedly commenced in the spring of 1975. It is unclear when this practice ended, although internal WLI memos indicated its continuation through 1980.

300147



0 200 400
SCALE IN FEET

300148

FIGURE 2-7

NUS CORPORATION

LOCATION OF BORINGS AND MONITORING WELLS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

300148

Standpipes

Several groundwater "standpipes" were located just east of the main process buildings and waste pit in the late 1970s to permit groundwater sampling in this area (see Figure 2-6). A 1977 analytical sheet indicated that wastewaters in the dike around a railroad car were pumped into the ground via standpipes. An analysis of the wastewater showed it to contain 26.4 mg/l arsenic. It is probable that the diked railroad tank car is tank T-9, which received process wastewater for either onsite treatment or direct shipping.

A 1980 WLI memo described a situation where a process water holding tank for arsanilic production overflowed into a diked area. Water from this diked area was pumped "into a groundwaterpipe." It is likely that one of the standpipes was used for this disposal.

Diked Areas

In 1970 a transfer line broke, allowing 800 gallons of aniline water to get into a dike south of Building 6. This dike leaked and the aniline water entered both the subsurface and Tulpehocken Creek.

An internal WLI 1972 memo indicated that one of the dikes receiving PCE-aniline process overflow leaked and the solvent found its way to the subsurface. This solvent entered the terra cotta sewer pipe via cracks.

The exact location of these leaks are unknown. Possibly there is residual contamination in the subsurface from these events.

"The Field"

Wash water rinses from ethylenediamine dihydroiodide (EDDI) and potassium iodide production (which occurred in Building 8) were commonly pumped into "the field," according to a 1980 WLI memo. A 1982 memo contained reports that unspecified wastewaters were commonly disposed in "the field." The exact location of this field has not been identified.

Sewage Treatment Plant (STP) Sludge

As stated above, the Myerstown STP has had a problem with arsenic from contaminated groundwater infiltrating into its sewer lines. To alleviate this problem, the STP has sliplined (encased) its sewer lines and applied sealant to its manholes in the Whitmoyer area to lessen infiltration. However, infiltration is still occurring to some degree. The latest STP analysis (September 2, 1987) showed the inflow from Myerstown to contain 29 μg/l arsenic. The STP operator stated that the inflow arsenic concentration varies seasonally as the groundwater table rises and falls, with higher arsenic concentrations occurring during high groundwater table periods.

300149

The STP adds ferric chloride to its inflow to precipitate phosphate. Concurrently, a large portion of the arsenic is also precipitated. The precipitated arsenic is present in the digester sludge. The last two analyses of this sludge, dated July 9, 1986 and May 29, 1987, assayed 14.1 mg/l and 40.0 mg/l arsenic, respectively. The sludge averages 5 to 7 percent solids (by weight). Assuming 6 percent solids and a sludge water content of 29 µg/l, the solids would assay 234 mg/kg and 667 mg/kg, respectively. As a point of comparison, the sludge contained 201 mg/kg arsenic when analyzed in January of 1974 (when the infiltration problem was much worse).

The STP generates approximately 600,000 gallons of sludge per year. Up to the last 2 years, the sludge was disposed on a nearby farm. Due to PADER concerns about zinc, this practice was discontinued; the sludge is now disposed on an adjacent farmer's fields.

The sludge application rate has been 7,500 gallons per 5-acre parcel per year. Assuming 6 percent solids, this is the equivalent of adding 0.001 inches of sludge solids per application on the affected acreage. Thus it is likely that any arsenic added to the soil is "diluted" by the tilling process.

A PADER representative who was concerned about arsenic addition to the farm fields collected several samples for arsenic analysis. No anomalous arsenic levels were encountered.

2.2.5.6 Contaminated soils

In addition to the various source areas listed above, it is believed that a significant amount of contaminated soils exist at the site. Two primary mechanisms are believed to be responsible for these soils. These mechanisms are condensation of evaporated wastes, and adsorption of contaminants present in the groundwater.

In the summer of 1978, a portion of the stack emissions condensed and dropped out in the nearby farmers' fields. This fallout damaged one farmer's (Grumbine's) corn crop to the east of the site. It is believed that arsenic was the contaminant which damaged the corn. It is not known whether this was an isolated incident or not. Waste evaporation occurred at the site from 1972 until the mid-1980s.

Three sets of samples of non-source soils were collected. The first and most extensive set was collected by R&H in 1965. This program involved the augering of 53 holes from the site and sample collection from certain intervals. Although the logs for these borings were found, the analytical results were not.

In 1973 the U.S. Geological Survey (USGS), as part of its study of arsenic in the Tulpehocken Creek basin, augered new holes at the same location as selected holes from the 1965 campaign.

300150

Samples were collected from the same depth intervals. The samples were split with R&H and analyzed by both parties.

In July 1987, the USEPA TAT hand-augered four holes in the vicinity of four of the holes placed by USGS in 1973. Due to equipment limitations, the TAT sampled only the top 3 feet of soil.

The available results from the three sampling events are shown in Table 2-6. The sample locations are shown in Figure 2-7. Many items can be extrapolated from this data. First, the EPA results indicate that elevated arsenic levels are present in the top 3 feet of soil on the island formed by Tulpehocken Creek and the Union Canal. These results lend support to the theory of this soil being contaminated by stack emissions or contact with groundwater.

Second, greater arsenic concentrations are present in soil just above the bedrock than in other subsurface soils when compared. For example, in 1965, when two or more intervals per borehole were available for comparison (A2, A3, A5, A9, A13, A17, A20, A22, A24, A30, and A32), the samples collected just above bedrock contained 78 percent more arsenic than the other subsurface samples.

Third, samples in contact with groundwater in 1973 contained more arsenic than samples not in contact with groundwater. Eight boreholes (A2, A3, A5, A9, A13, A17, A24, and A30) had one wet interval and one dry interval in 1973. The R&H and USGS wet interval results contained 105 percent and 118 percent more arsenic, respectively, than the corresponding dry intervals.

A nearby resident reported that the lagooning operations in the 1960s caused a groundwater mound near the site. This mound caused fields to the north, west, and east of the site to become saturated with groundwater. If this groundwater contained significant arsenic concentrations which adsorbed onto the surface soils, a direct contact pathway from offsite soils may exist. A sample of sediment from a ditch on the east side of Fairlane Avenue across from the site contained 2,950 mg/kg As when sampled in November of 1964 (the ditch water content was 82.5 mg/l As).

Fourth, the R&H and USGS 1973 split analytical results did not agree very well. With the exception of A22 results, the USGS results were roughly twice as high as R&H results. The R&H 1973 results were approximately 40 percent of the 1965 results, while the USGS results were roughly 125 percent of the 1965 results. Thus, one cannot say whether the soil arsenic levels increased or decreased during the period or what the absolute arsenic concentrations were with confidence.

300151

TABLE 2-6

ARSENIC CONCENTRATIONS IN AUGERED SOIL SAMPLES
WHITMOYER LABORATORIES SITE

Hole Number	Sample Depth (feet)	Depth to Water 1965	Depth to Water 1973	Depth to Bedrock (feet)[1]	Total Arsenic Concentration (mg/kg)			
					2/65[2]	8/73[2]	8/73[3]	7/87[4]
A1	4.0-5.0	Dry	Dry	6.8	29	300	320	
A2	4.0-5.0	Dry	6.5	8.2	1,000	190	400	
	7.2-8.2				1,200	980	2,200	
A3	0.0-3.0	6.2	4.5	16.0				3,150
	2.0-3.0				600	720	870	
	7.0-8.0				1,900	890	1,600	
	12.0-13.0				1,500	-	-	
	15.0-16.0				270	-	-	
A5	0.0-3.0	2.2	5.6	7.4				1,540
	3.0-4.0				400	260	590	
	6.4-7.4				420	820	1,100	
A9	0.0-3.0	3.2	5.7	8.8				350
	4.0-5.0				16	330	600	
	7.0-8.8				120	480	650	
A13	0.0-3.0	1.9	5.7	7.8				102
	3.0-4.0				190	280	680	
	6.8-7.8				200	240	540	

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TABLE 2-6
ARSENIC CONCENTRATIONS IN AUGERED SOIL SAMPLES
WHITMOYER LABORATORIES SITE
PAGE TWO

Hole Number	Sample Depth (feet)	Depth to Water 1965	Depth to Water 1973	Depth to Bedrock (feet)[1]	Total Arsenic Concentration (mg/kg)			
					2/65[2]	8/73[2]	8/73[3]	7/87[4]
A17	4.0-5.0	5.2	6.0	12.0	4.5	8.4	20	
	10.0-12.0				20	16	26	
A20	3.0-4.0	Dry	Dry	6.4	9.8	30	54	
	5.0-6.4				93	28	29	
A22	4.0-5.0	6.2	4.0	11.8	7,600	1,600	11,000	
	10.0-11.8				13,700	1,880	12,000	
A24	4.0-5.0	6.7	6.0	10.8	16	26	76	
	9.8-10.8				194	120	620	
A30	3.0-4.0	Dry	4.8	7.4	177	12	36	
	6.4-7.4				295	190	410	
A32	4.0-5.0	Dry	8.0	8.2	36	1,170	2,000	
	7.2-8.2				2,500	710	1,800	
A42	2.8-3.8	Dry	Dry	3.8	270	360	590	
A45	4.0-5.1	2.0	4.0	5.1	340	860	1,200	

1 Based on 1965 log data
2 Analyses by Rohm and Haas
3 Analyses by U.S. Geological Survey
4 Analyses by USEPA Technical Assistance Team

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2.2.5.7 Onsite Groundwater

As part of the existing data compilation, data from onsite monitor wells and piezometers were compiled for the site. As would be expected, there is a wealth of data from the period when the pump and treat program was occurring. Due to the volume and age of this data, it will not be discussed here.Rather, data from the last 10 years on arsenic, aniline, and PCE has been compiled. No post-1984 data from these wells was identified. Information on the onsite wells is contained in Table 2-7. Their locations are shown in Figure 2-7.

As can be seen in Table 2-8, the arsenic values for the onsite wells appears to have declined somewhat from 1978 to 1984. The sole exception to this is well 4. However, every well has groundwater arsenic concentrations in the mg/l range. When measured in 1968, the arsenic in groundwater was approximately 60 percent inorganic and 40 percent organic.

Also of note is that all of the wells, which ring the site, have significant arsenic levels. Thus, none of these wells can be considered a background well.

The onsite wells were only sampled once for Methods 624 and 625 volatiles and base/neutral/acid extractables. This sampling, which was conducted by the USEPA TAT in February 1984, only encompassed wells 4 and 7. As can be seen in Table 2-9, benzene, chlorobenzene, chloroform, 1,1-dichloroethane, trans-1,2-dichloroethene, ethylbenzene, methylene chloride, PCE, toluene, TCE, phenols, acenaphthene, fluorene, fluoranthene, naphthalene, phenanthrene, and pyrene were all detected in significant quantities.

The onsite wells were also sampled numerous times in the period 1980-1983 by WLI for aniline and perchloroethylene. The analytical results are shown in Table 2-10. The 1984 USEPA TAT results are also shown for comparison. As can be seen, samples collected from wells 3, 4, and 7 historically have had elevated aniline concentrations, and wells 4 and 7 historically have had elevated perchloroethylene concentrations.

In June and July 1981, WLI sampled seven standpipes (piezometers) located east of the main process building and west of Building 23 for arsenic, aniline, and PCE on five occasions (see Figure 2-6 for standpipe locations). A large variation in sampling results was observed. Arsenic values ranged from 0.65 mg/l to 428 mg/l, with the average being 68 mg/l. Aniline concentrations ranged from less than 2 to 3,826 mg/l, with the average being 438 mg/l. Finally, PCE concentrations ranged from less than 0.5 mg/l to 5 mg/l, with the average being approximately 0.7 mg/l (see Table 2-11). Since some of these standpipes were used for wastewater disposal, the groundwater concentrations are not comparable.

300154

TABLE 2-7

MONITORING WELL INFORMATION
WHITMOYER LABORATORIES SITE

Well No.	Depth Below Land Surface	Casing Depth	Soil Cover	Comments
1*	350	42	-	
2*	400	22	-	
3*	29	-	-	
4*	315	-	-	
5A*	158	13	2	
5*	30	15	2	
6*	30	14	4	
7*	52	17	4	Enlarged fracture at 22 feet
8	98	10.5	9	
8A	118	17.5	11	
8B	100	34	15	
9*	97	9	8	
9A*	100	12	10.5	
10	110	8.5	7	
10A*	98	12.5	11	
10B	56	10.5	4	
11*	98	13	8	
11A	36	12.5	12.5	
12	118	6.5	3.5	
12A	98	6.5	4	
13	138	8	4.3	
13A	190	7	3.5	
14	132	12.5	10	Caved
15	97	20	8	Backfilled
15A	60	13	8.5	
15B*	100	16	9.5	

TABLE 2-7
MONITORING WELL INFORMATION
WHITMOYER LABORATORIES SITE
PAGE TWO

Well No.	Depth	Casing Depth	Soil Cover	Comments
16	118	9	6	
16A	77	10.5	7	
16B*	120	42	10	
17*	70	14	9	
17A	60	20	18	

* Pump and treat well
** Original pumping well, which was replaced by 5A

300156

TABLE 2-8

AVERAGE TOTAL ARSENIC CONCENTRATIONS FROM ONSITE MONITORING WELLS (1978-1984) WHITMOYER LABORATORIES SITE

(All Data in mg/l)								
Year	No. of Samples	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7
1978	5	24.7	61.8	120.4	41.1	86.4	133.0	222.5
1979	12	22.4	2.2	21.1	56.7	82.7	120.1	179.5
1980	11	35.7	4.3	21.5	67.5	96.1	132.7	198.4
1981	10	19.9	1.5	27.6	73.9	87.8	122.2	144.1
1982	5	10.7	4.5	28.5	87.1	48.1	116.3	176.2
1983	1	6.4	<4.5	18.7	61.0	78.2	60.0	148.6
1984(1)	2	NM	NM	NM	86.5	NM	NM	147.5

(1) USEPA TAT results
NM = Not Measured

300157

TABLE 2-9

USEPA TECHNICAL ASSISTANCE TEAM WELL SAMPLING RESULTS
MONITORING WELLS NO. 4 AND NO. 7
FEBRUARY 17, 1984
WHITMOYER LABORATORIES SITE
(All data in ug/l)

	Monitoring Well No. 4	Monitoring Well No. 7
Arsenic	133,000	69,000
Aniline	>1,000	700
Benzene	51	32
Chlorobenzene	5	14
Chloroform	2	5
1,1-dichloroethane	150	73
Trans-1,2-dichloroethene	6,000	4,000
Ethylbenzene	62	17
Methylene Chloride	35	36
Perchloroethylene	4,000	4,000
Toluene	14	10
Trichloroethene	2,000	2,000
Total Phenols	130	190
Acenaphthene	ND	2,000
Fluoranthene	ND	60
Fluorene	ND	1,200
Naphthalene	260	30
Phenanthrene	ND	400
Pyrene	ND	80

ND = Not Detected

300158

TABLE 2-10

AVERAGE CONCENTRATION OF ORGANIC CONTAMINANTS
IN ONSITE GROUNDWATER
WHITMOYER LABORATORIES SITE
(All Data in mg/l)

Aniline

Year	No. of Samples	Well No. 1	Well No. 2	Well No. 3	Well No. 4	Well No. 5	Well No. 6	Well No. 7
1973	1	<1	<1	<1	<1	<1	227	1,080
1980	6	5	<2	42	210	<2	<2	9,230
1981	10	<3	<3	25	18	<3	<3	4,160
1982	5	<2	<2	8.4	4	<2	<2	2,070
1983	1	<2	<2	<2	3.7	<2	<2	1,790
1984*	1	NM	NM	NM	0.7	NM	NM	>1***

Perchloroethylene

Year	No. of Samples	Well No. 1	Well No. 2	Well No. 3	Well No. 4	Well No. 5	Well No. 6	Well No. 7
1980	6	1.6*	1.9**	2.2**	95	2.2**	2.2**	12
1981	10	<0.5	<0.5	<0.5	31	<0.5	<0.5	13
1982	4	<0.5	<0.5	<0.5	34	<0.5	0.5	8.8
1983	1	<0.5	<0.5	<0.5	1.0	<0.5	<0.5	2.0
1984*	1	NM	NM	NM	4.0	NM	NM	4.0

NM = Not Measured
* USEPA TAT Data
** These data appear to be outliers
*** The analyst estimated that concentration to be in the percent range

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TABLE 2-11

CONCENTRATIONS OF CONTAMINANTS IN GROUNDWATER
FROM SAMPLES: ONSITE STANDPIPES, 1981
WHITMOYER LABORATORIES SITE

Arsenic, mg/l

	A	B	C	D	E	F	G
06/25/81	101	NM	6.65	0.71	428	87	109
07/02/81	186	NM	1.38	0.86	104	22.2	29.4
07/09/81	193	35.5	2.06	0.65	13.7	24.2	45.6
07/16/81	240	38.8	2.5	1.10	117.5	27.2	81
07/23/81	198.5	26.6	1.88	1.12	99	33.8	50
Average	183.7	33.6	2.89	0.89	152.4	38.9	63.0

Aniline, mg/l

06/25/81	<3.61	<3.40	<3.40	<3.5	3,826	1,091	<3.44
07/02/81	206	15.2	16.4	<3.4	13.7	646	<3.36
07/09/81	207	92.4	18.4	<2.45	1,544	616	<2.29
07/16/81	85.5	122.8	36.7	<2.45	2,713	568	<1.91
07/23/81	50.5	26.6	1.88	1.12	2,740	689	7.07
Average	109.8	51.4	14.7	<2.45	2,167	722	<2

Perchloroethylene, mg/l

06/25/81	2	1	<0.5	<0.5	<0.5	5	<0.5
07/02/81	<0.5	<0.5	<0.5	<0.5	1	2	<0.5
07/09/81	4	<0.5	2	2	<0.5	2	<0.5
07/16/81	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
07/23/81	2	1	1	<0.5	0.7	0.7	0.6
Average	1.6	0.4	0.6	0.4	0.3	1.9	<0.5

NM = Not measured

300160

2.2.5.8 Offsite Groundwater

As stated above, more than 30 residential wells were found to be contaminated with arsenic in 1964 when the R&H investigation commenced. The groundwater pump and treat program significantly reduced the arsenic concentrations in most of these wells. However, many of the groundwater samples collected from these wells continued to have arsenic concentrations above the drinking water standard of 50 µg/l, necessitating the use of bottled water for local residents. Bottled water continued to be supplied to many residents through 1984.

As part of the data compilation, analytical data from residential wells was compiled from 196£ to the present. The compiled arsenic data are portrayed in Table 2-12. The corresponding well locations are shown on Figure 2-8. As points of reference, data from offsite monitor well 16B (Sterling Drug property) and PJ Hydraulics' east (office) and west (factory) wells have been included in the tables along with the residential data.

As can be seen from the arsenic data, the offsite wells' arsenic values decreased from 1968 to 1971 as the pump and treat program was occurring. Most of the wells showed an increase in arsenic in 1972, the first full year after the end of pumping, when compared to 1971.

In late 1976 and early 1977, the lagoons were consolidated. Some benefit appears to have been realized by consolidation, when comparing 1976 data to 1978 data.

Table 2-13 presents arsenic, aniline, and PCE data for monitor well 16B, which is located on the Sterling Drug property east of the Whitmoyer plant site. As can be seen, significant concentrations of arsenic (75.2 mg/l average), aniline (684 mg/l average), and PCE (3 mg/l maximum) were found. No other analyses were performed.

Table 2-14 presents the existing organic data for the remainder of the offsite wells. As can be seen, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene, cis-1,2-dichloroethene, PCE, TCE, toluene, and 1,1,1-trichloroethane were detected in residential wells. Most of these same wells have elevated arsenic values. It is uncertain at this point whether these organics, especially the 1,1,1-trichloroethane, can be attributed exclusively to the Whitmoyer Laboratories site. Many of these same volatile organic contaminants were identified in onsite monitoring wells by the USEPA TAT in 1984.

It should be noted that the aniline detection limits in Table 2-14 are rather high, due to the analytical methods employed by WLI. This may explain why no aniline was detected in offsite wells other than well 16B (Sterling Drug).

TABLE 2-12

AVERAGE CONCENTRATIONS OF ARSENIC IN OFFSITE WELLS
WHITMOYER LABORATORIES SITE
(All Data in µg/l)

	USGS Code	Well Depth	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Krieder	LB 626	9	210	190	90	60	130	280		30	30		30
Peiffer (Hold.)	LB 783	100	140	150	50	80	110	260					50
PJ Valves	LB 784	470	390	90	50	20	50	60		60	70		45
Gibble		185	510	240	80	40	80	70		80	160		52
Hurst (Smith)	LB 780		820	190	20	60	250	130		170	110		52
Swanger		61	1,380	1,300	1,080	330	850	1,070		1,420	430		420
Layser	LB 779		230	250	210	50	190	130		90	60		56
Wenger	LB 778		130	70	70	40	60	100			50		42
Wenger (Farm)	LB 782												
Eiceman	LB 772	200	180	120	40	30	30	20		30	90		30
Holtzman	LB 770	250						ND					16
Mays	LB 771	77	30	30	30	10	10	20		20	20		27
Sauter (Diem)		100	60	30	30	10	10	10		20	10		15
Sauter (Barn)	LB 774				45	20	16						
Weaver		22	50	40	10	40	10	10		10	10		10
Mandra (Brown)	LB 381		32	30	20		10	10			20		15
Beyler G. M.	LB 785	355	60	50	30	10	20	20		20			10
Moore		230	31	20	10				10	100			
Zimmerman		100											
Martin													

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TABLE 2-12
AVERAGE CONCENTRATIONS OF ARSENIC IN OFFSITE WELLS
WHITMOYER LABORATORIES SITE
(All Data in µg/l)
PAGE TWO

	USGS Code	Well Depth	1979	1980	1981	1982	1983	1984	1985	1986	1987	%Change 1978-1987
Krieder	LB 626	9				97					55	83.3
Peiffer (Hold.)	LB 783	100										
PJ Valves	LB 784	470										
Gibble		185				81			133		145	178.8
Hurst (Smith)	LB 780					53	18				70	34.6
Swanger		61				166			445		344	-18.1
Layser	LB 779					66	48		37		39	-30.4
Wenger	LB 778					63	38		31		26	-38.1
Wenger (Farm)	LB 782								16		17	
Eiceman	LB 772	200			198	94			76		61	103.3
Holtzman	LB 770	250	13	40	25	21			5			
Mays	LB 771	77	20	19	25	16	17				19	-29.6
Sauter (Diem)		100	16	12	23	23	18		5		12	-20.
Sauter (Barn)	LB 774					21					14	
Weaver		22	6	11		8						
Mandra (Brown)	LB 381											
Beyler G. H.	LB 785	355										
Moore		230										
Zimmerman		100				<5			<4		7	
Martin						<5					5	

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TABLE 2-12
AVERAGE CONCENTRATIONS OF ARSENIC IN OFFSITE WELLS
WHITMOYER LABORATORIES SITE
(All Data in µg/l)
PAGE THREE

	USGS Code	Well Depth	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
High													
Harnish, G.													
Shaak, Jr.													
Shaak													
Dohner													
Wagner													
Schoen													
Messerschmidt, E.	LB 553	260											
Messerschmidt, F.													
Donmoyer		100	9,560	9,890	5,110	4,630	WC	WC	WC	WC	WC	WC	WC
Wartluft			410	1,610	390	183	70						
Sterling, 16B	LB 759	120	52,110	21,950	18,776	15,930	26,747						
Lutz	LB 688	250						ND					
Beamesderfer													
Harnish, D.													
Marks													
Courtney													
Gockley													
Brown													
Kohl													

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TABLE 2-12
AVERAGE CONCENTRATIONS OF ARSENIC IN OFFSITE WELLS
WHITMOYER LABORATORIES SITE
(All Data in μg/l)
PAGE FOUR

	USGS Code	Well Depth	1979	1980	1981	1982	1983	1984	1985	1986	1987	%Change 1978-1987
High												
Harnish, G.												
Shaak, Jr.												
Shaak												
Dohner												
Wagner												
Schoen												
Messerschmidt, E.	LB 553	260										
Messerschmidt, F.												
Donmoyer		100	WC	WC	WC	WC	WC	WC	WC	WC	WC	WC
Wartluft												
Sterling, 16B	LB 759	120			81,100	65,333						
Lutz	LB 688	250									<4	
Beamesderfer									<4			
Harnish, D.						<5					<4	
Marks						<5					<4	
Courtney						<5						
Gockley									<4			
Brown									<4			
Kohl											<4	

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TABLE 2-12
AVERAGE CONCENTRATIONS OF ARSENIC IN OFFSITE WELLS
WHITMOYER LABORATORIES SITE
(All Data in µg/l)
PAGE FIVE

	USGS Code	Well Depth	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Yeokley													
Crouse													
Hall													
Hauer													
Wubb													
Schrock													
Neuman													

	USGS Code	Well Depth	1979	1980	1981	1982	1983	1984	1985	1986	1987	%Change 1978-1987
Yeokley											<4	
Crouse											<4	
Hall											<4	
Hauer											<4	
Wubb											<4	
Schrock											5	
Neuman											15	

ND - None Detected
WC - Well Closed

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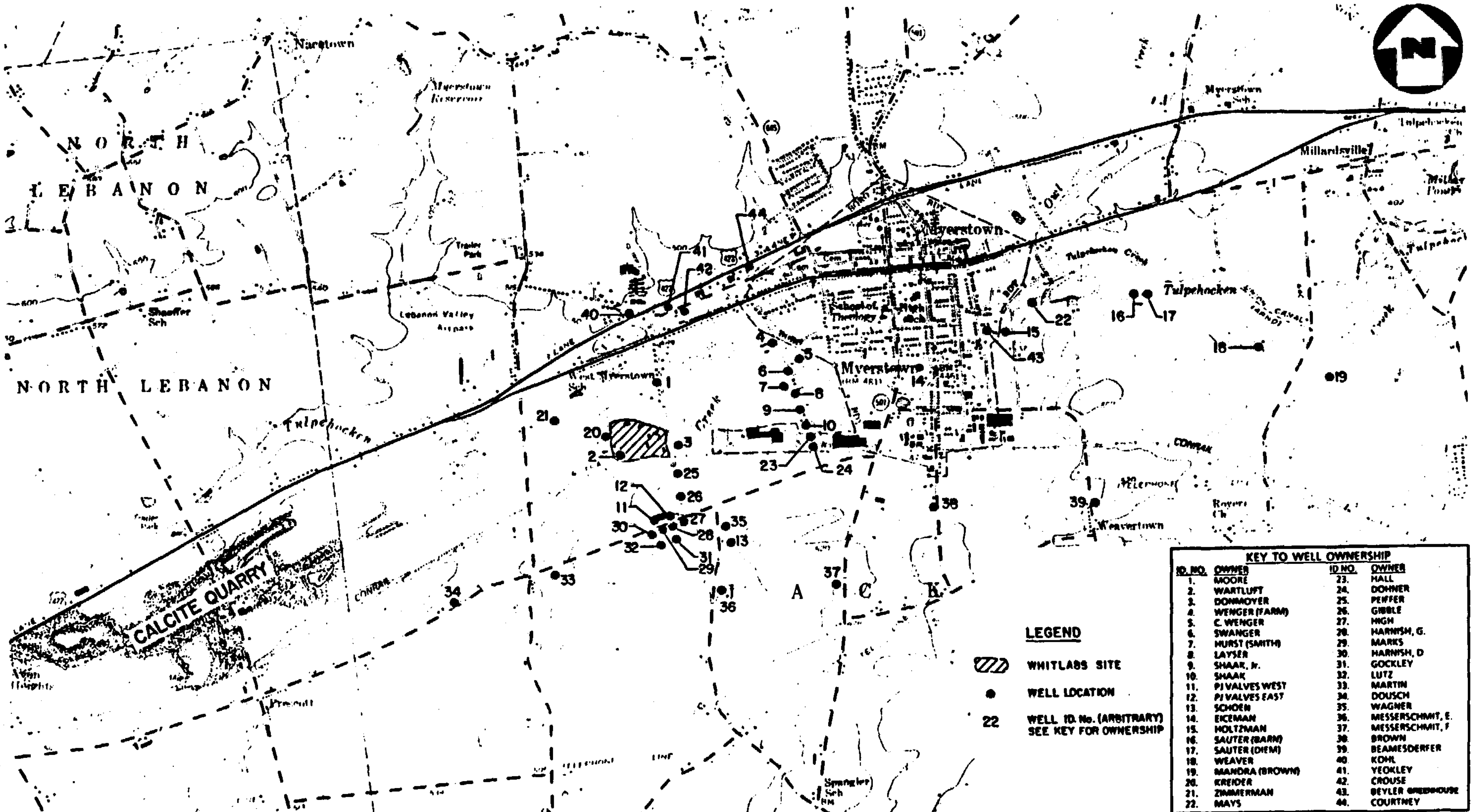

KEY TO WELL OWNERSHIP

ID. NO.	OWNER	ID NO.	OWNER
1.	MOORE	23.	HALL
2.	WARTLUFT	24.	DOHNER
3.	DONMOYER	25.	PEFFER
4.	WENGER (FARM)	26.	GIBBLE
5.	C. WENGER	27.	HIGH
6.	SWANGER	28.	HARNISH, G.
7.	HURST (SMITH)	29.	MARKS
8.	LAYSER	30.	HARNISH, D
9.	SHAAK, Jr.	31.	GOCKLEY
10.	SHAAK	32.	LUTZ
11.	PJ VALVES WEST	33.	MARTIN
12.	PJ VALVES EAST	34.	DOUSCH
13.	SCHOEN	35.	WAGNER
14.	EICEMAN	36.	MESSERSCHMIT, E.
15.	HOLTZMAN	37.	MESSERSCHMIT, F
16.	SAUTER (BARN)	38.	BROWN
17.	SAUTER (DIEM)	39.	BEAMESDERFER
18.	WEAVER	40.	KOHL
19.	MANDRA (BROWN)	41.	YEOKLEY
20.	KREIDER	42.	CROUSE
21.	ZIMMERMAN	43.	BEYLER GREENHOUSE
22.	MAYS	44.	COURTNEY

BASE MAP IS A PORTION OF THE U.S.G.S. RICHLAND, PA QUADRANGLE (7.5 MINUTE SERIES, 1955, PHOTOREVISED 1969). CONTOUR INTERVAL TWENTY (20) FEET.

FIGURE 2-8

0 2000 4000
SCALE IN FEET

LOCATION OF SELECTED WATER WELLS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

NUS CORPORATION

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TABLE 2-13

CONCENTRATIONS OF ARSENIC, ANILINE AND PERCHLOROETHYLENE FROM 1981-1983 SAMPLES OFFSITE WELL 16B AT STERLING DRUG COMPANY WHITMOYER LABORATORIES SITE (All Data in mg/l)

Date	Arsenic	Aniline	Perchloroethylene
02/05/81	85.5	64.0	<0.5
03/31/81	52.2	192.5	0.6
05/05/81	52.2	263.0	<0.5
06/01/81	53.2	351.0	<0.5
06/23/81	70.4	229.0	<0.5
07/30/81	202.0	957.3	<0.5
10/05/81	85.5	144.9	<0.5
10/28/81	57.5	183.0	<0.5
11/03/81	82.5	185.2	1.0
12/02/81	70.0	98.5	3.0
01/05/82	65.2	314.0	<0.5
02/03/82	63.0	337.3	<0.5
03/05/82	63.2	479.5	<0.5
06/14/82	52.0	1,644.0	1.0
09/07/82	67.0	4,797.8	<0.5
06/20/83	81.6	697.0	1.0
Average	75.2	684.0	-
Maximum	202.	4,797.8	3.0
Minimum	52.0	64.0	<0.5

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TABLE 2-14

CONCENTRATIONS OF VOLATILE ORGANIC CONTAMINANTS AND ANILINE
FROM OFFSITE RESIDENTIAL AND INDUSTRIAL WELLS
WHITMOYER LABORATORIES SITE
(All Data in µg/l)

Well	Date	1,1-DCA	T-1,2-DCE	1,1,1-TCA	TCE	PCE	1,2-DCA	ANL	C-1, 2-DCE	1,1-DCE	TOL	Sampler
Gibble	6/20/85	8.5	100.	400.	187.	120.						PADER
Gibble	11/4/87	27.	0.46	425.	19	11.				3.8		EPA
Eiceman	10/22/87					1.0			1.0			PADER
Eiceman	11/4/87					0.26						EPA
Layser	1/24/83							<290				WLI
Layser	8/11/87					1.2						PADER
Layser	11/4/87					1.2						EPA
Wenger	1/24/83							<170				WLI
Wenger	11/4/87			0.55		0.27						EPA
Wenger (farm)	08/12/85											PADER
Wenger (farm)	11/04/87			3.4		0.67						EPA
High	4/9/85	9.3	43.9	≥309.2	22.3	15.7						PADER
High	11/4/87	113	0.3	557	16	8.5				4.7		EPA
Hurst	1/24/83							<200				WLI
Hurst	9/8/87					1.6			1.4			PADER
Hurst	11/09/87											EPA
PJ Valves (east)	11/4/87	95.	0.2	258	23.	11.				3.1		EPA
PJ Valves (west)	11/4/87	15.		55	2.2	0.85				4.4		EPA
Wagner	06/20/85											PADER
Wagner	11/04/87											EPA
Dousch	08/12/85											PADER
Beamesderfer	08/12/85											PADER

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TABLE 2-14
CONCENTRATIONS OF VOLATILE ORGANIC CONTAMINANTS AND ANILINE
FROM OFFSITE RESIDENTIAL AND INDUSTRIAL WELLS
WHITMOYER LABORATORIES SITE
(All Data in µg/l)
PAGE TWO

Well	Date	1,1-DCA	T-1,2-DCE	1,1,1-TCA	TCE	PCE	1,2-DCA	ANL	C-1,2-DCE	1,1-DCE	TOL	Sampler
Sauter	2/3/80					<500		<5,000				WLI
Sauter	12/6/80					<500		<5,000				WLI
Sauter	1/6/82					<500		<2,250				WLI
Sauter	1/24/83							<440				WLI
Sauter	10/22/87			1.0		1.0						PADER
Sauter	11/4/87			1.1		0.23						EPA
Sauter (barn)	11/4/87			0.31								EPA
Harnish G.	11/9/87	24.		275.	6.4	3.5	1.3		43.0			PADER
Mays	2/3/80					<500		<5,000				WLI
Mays	12/6/80					<500		<5,000				WLI
Mays	1/6/82					<500		<2,310				WLI
Mays	1/24/83							<270				WLI
Mays	11/4/87			1.0		0.22						EPA
Martin	6/20/85			25.								PADER
Martin	11/4/87			5.8								EPA
Harnish D	11/9/87	1.0									5.	PADER
Schoen	5/9/85	1.5	5.3	105.4	7.7	4.0				2.0		PADER
Schoen	11/4/87	5		99	8.8	5.7				1.7		EPA
Shaak	11/04/87											EPA
Messerschmidt, E	06/20/85											PADER

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TABLE 2-14
CONCENTRATIONS OF VOLATILE ORGANIC CONTAMINANTS AND ANILINE
FROM OFFSITE RESIDENTIAL AND INDUSTRIAL WELLS
WHITMOYER LABORATORIES SITE
(All Data in µg/l)
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Well	Date	1,1-DCA	T-1,2-DCE	1,1,1-TCA	TCE	PCE	1,2-DCA	ANL	C-1, 2-DCE	1,1-DCE	TOL	Sampler
Zimmerman	6/20/85			1.3								PADER
Brown	8/12/85			5.9								PADER
Messerschmidt F.	8/12/85			1.7								PADER
Messerschmidt F.	11/4/87			1.6								EPA
Kreider	2/2/82					<500		<1,900				WLI
Kreider	3/5/82					<500		<2,130				WLI
Kreider	6/14/82					<500		<2,400				WLI
Kreider	11/4/87			1.4								EPA
Weaver	2/3/80					<500		<5,000				WLI
Weaver	12/6/80					<500		<5,000				WLI
Weaver	1/6/82					<500		<2,160				WLI
Holtzman	2/3/80					<500		<5,000				WLI
Holtzman	12/6/80					<500		<5,000				WLI
Holtzman	1/6/82					<500		<2,200				WLI
Swanger	11/4/87			2.8	1.5							EPA
Shaak, Jr.	11/4/87				0.61	1.4						EPA

ND = None Detected
ANL = Aniline
TCE = Trichloroethylene
PCE = Perchloroethylene
TOL = Toluene
Blank boxes mean not analyzed for WLI data
Blank boxes mean not detected for EPA and PADER data

1,1-DCA = 1,1-dichloroethane
1,2-DCA = 1,2-dichloroethane
1,1-DCE = 1,1-dichloroethylene
C-1,2-DCE = cis-1,1-dichloroethylene
T-1,2-DCE = trans-1,2-dichloroethylene
1,1,1-TCA = 1,1,1-trichloroethane

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2.2.5.9 Surface Water and Sediment

Water Quality Investigations

As stated above, Tulpehocken Creek is used for recreation and fishing at and near the site. Additionally, water from the creek is impounded and used as a drinking water and irrigation supply 14 miles downstream of the site.

Recent data is available on the arsenic concentrations in surface water and sediment at and near the site. PADER and USGS jointly monitor the stream quarterly. Additionally, the USEPA TAT has collected infrequent water and sediment samples from the creek.

Surface water data from 1980 to the present is contained in Table 2-15. As can be seen, no arsenic has been detected in thewater at the Prescott Drive Bridge upstream of the site. Similarly, only small quantities of arsenic are occasionally present as the creek enters the property. This arsenic could be due to the Calcite Quarry discharge or to contaminated groundwater discharge to the creek. The quarry discharge is located downstream of the Prescott Drive Bridge.

As stated above, the quarry continuously pumps water to enable quarrying operations to occur. Apparently the quarry's cone of depression causes groundwater under at least a portion of the site to be drawn into the quarry (the quarry's cone of depression appeared to include the entire site when last measured in 1981). The quarry discharge has contained as much as 35 µg/l arsenic (in 1964), but reportedly contained much less since the pump-and-treat program was initiated. Similarly, the cone of depression may cause groundwater discharge to the creek upstream of the site.

As can be seen in the data from Table 2-15, both the Union Canal and Tulpehocken Creek pick up arsenic where they pass the site. Some groundwater passes under the Union Canal and discharges to Tulpehocken Creek, which is 4 to 5 feet lower in elevation than the canal at the site. Substantial quantities of arsenic were added in the stretch from the canal at the extreme west end of the property to the canal culvert crossing, when this stretch was measured by WLI in 1980 and 1981. When the data are compared, a threefold increase in arsenic is noted. Furthermore, the creek arsenic concentrations at the Fairlane Avenue Bridge also were elevated when measured by WLI during this period. The majority of the arsenic appeared to remain in solution at the Above-Winthrop-Storm-Drain and College Avenue Bridge sample stations.

While there was an increase in arsenic concentrations, the actual concentrations did not approach the levels detected in groundwater. During the 1980s Tulpehocken Creek at the Fairlane Avenue Bridge did not exceed 204 µg/l total arsenic, or roughly four times the drinking water standard. The latest sample from

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TABLE 2-15

CONCENTRATIONS OF ARSENIC IN TULPEHOCKEN CREEK WATER SINCE 1980
WHITMOYER LABORATORIES SITE
(All Data in µg/l)

Date	Prescott Drive Bridge	Union Canal West End of Site	Union Canal at Culvert	Tulpehocken Creek at Fairlane Bridge	Tulpehocken Creek 100 Feet Above Winthrop	Tulpehocken Creek at College Avenue Bridge	Samples
01/31/80		51	144				WLI
03/27/80		21	48				WLI
04/30/80		34	106				WLI
05/28/80		31	35				WLI
06/13/80		44	116				WLI
06/23/80	<10				29	<10	PADER
07/15/80		4	8	184			WLI
08/19/80		5	18				WLI
09/11/80					35	3..6	PADER
09/29/80		6	16				WLI
10/08/80	<5				16.2	17.4	PADER
10/13/80		10	71				WLI
11/26/80		15	396				WLI
01/21/81		26	138				WLI
03/10/81	<10				68.0	79.8	PADER
03/18/81		146	65				WLI
04/20/81					87.7	170.3	PADER

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TABLE 2-15
CONCENTRATIONS OF ARSENIC IN TULPEHOCKEN CREEK WATER SINCE 1980
WHITMOYER LABORATORIES SITE
(All Data in μg/l)
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Date	Prescott Drive Bridge	Union Canal West End of Site	Union Canal at Culvert	Tulpehocken Creek at Fairlane Bridge	Tulpehocken Creek 100 Feet Above Winthrop	Tulpehocken Creek at College Avenue Bridge	Samples
04/29/81		5	22				WLI
06/09/81	<10				64.6	49.2	PADER
06/25/81(1)				105			WLI
07/02/81				49			WLI
07/09/81				134			WLI
07/16/81				204			WLI
07/23/81(1)				26			WLI
09/09/81	<5				18.5	16.3	PADER
03/10/82	<5				172	194.5	PADER
04/14/82	<5				<5	101.5	PADER
06/21/82	<5				52.9	<5	PADER
09/02/82	<5				<5	<5	PADER
12/09/82	<5				1,280.0	122.5	PADER
06/15/83	<5				39.1	38.5	PADER
02/09/84	<2		63			53	TAT
07/23/87			<5	17			TAT

(1) Aniline (<3.5 mg/l) and PCE (<0.5 mg/l) were not detected in June 25, 1981 to July 23, 1981 WLI sampling.

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the Fairlane Avenue Bridge, collected by the USEPA TAT in July 1987, contained only 17 µg/l arsenic. This low figure was obtained even though the sample collected from Union Canal just prior to the confluence with Tulpehocken Creek contained 580 µg/l arsenic. All of the data from the USEPA TAT sampling in July 1987 is contained in Table 2-16.

Tulpehocken Creek was sampled for aniline and perchloroethylene on five occasions in 1981. No aniline or PCE was detected. However, methods with high detection limits (approximately 2.0 to 3.5 mg/l for aniline and 0.5 mg/l for PCE) were used.

Sediment Data

Sediment data from the Tulpehocken Creek drainage is less prevalent. This data has been compiled back to 1964 to permit data comparison over time. Also, with this time span, the change in sediment arsenic concentration during the groundwater pump and discharge program can be evaluated. This data is presented in Table 2-17 from upstream to downstream.

As can be seen, the sediment at both the Prescott Drive Bridge and 1,050 feet west of the plant appears to be at background levels (<3 mg/kg to 5.5 mg/kg As). The sediment arsenic concentration increases dramatically as the creek and canal pass the site, e.g., the creek sediment from just east of the Fairlane Avenue Bridge assayed 390 mg/kg arsenic when sampled by TAT in 1987. The sediment concentrations slowly decrease downstream of the site.

The only data available after 1972 is 1980 PADER data and 1984 and 1987 USEPA TAT data. No arsenic was detected in the 1980 sediment samples collected from Tulpehocken Creek. The detection limit was not specified. With only three sets of data from after 1972, it is difficult to reach any conclusions regarding changes in the sediment concentration over time.

The U.S. Army Corps of Engineers (USACE) has an ongoing monitoring program at the Blue Marsh Lake project 14 miles downstream of the site. A consultant's report prepared prior to the project completion cautioned that there was a potential release of arsenic from the lake sediment to the water under anaerobic conditions. This arsenic release has not been detected to any great degree by the monitoring program. A USACE representative speculated this may be due to the lake being too shallow to go strongly anaerobic.

In 1987 8 surface water stations in the lake were sampled 16 times over the course of the year. None of the samples exceeded 12 µg/l arsenic, with the vast majority being much below this figure. Sediment samples from these eight stations were collected twice during the year. The arsenic sediment concentrations ranged from 2.8 to 24.0 mg/kg dry weight.

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TABLE 2-16

JULY 1987 USEPA TAT
TULPEHOCKEN CREEK WATER SAMPLE RESULTS
(ARSENIC - µg/l)
WHITMOYER LABORATORIES SITE

Site	Concentration
Union Canal north of vault	<5
Union Canal between vault and fish pond	<5
Union Canal below fish pond	<5
Union Canal just before confluence	580
Tulpehocken Creek north of pasture	<5
Tulpehocken Creek east of Fairlane Avenue Bridge	17

3001.76

TABLE 2-17

ARSENIC CONCENTRATIONS IN TULPEHOCKEN CREEK SEDIMENT SAMPLES
WHITMOYER LABORATORIES SITE
(mg/kg unless otherwise indicated)

Site	Nov. 1964 (1)	May 1968 (1)	June 1969 (1,6,7)	Aug. 1969 (1)	Feb. 1970 (1,8)	July 1970 (1)	Aug. 1970 (1)	Sept. 1970 (1)	Nov. 1970 (1)	Jan. 1971 (1)	Sept. 1971 (4,9)	Aug. 1972 (1)	Fall 1972 (5)	March 1980 (4)	Feb. 1984 (2)	July 1987 (2)	July 1987 (2,3)
Prescott Drive Bridge, 3 miles west of site															5.5		
Tulpehocken Creek, 0.5 miles west of site	<3	3.6	3.1	4.3	7.9	1.9	8.4	36.4	6.8	8.2	3	4.6		ND			
Union Canal above vault																52	1.2
Union Canal at vault	866	128	567	919	610	847	1,225	177	630	677		292				70	1.1
Union Canal between vault and fish pond																59	1.0
Union Canal below fish pond																55	0.8
Tulpehocken Creek north of vault	163															102	1.0
Tulpehocken Creek north of fish pond																156	0.75
Tulpehocken Creek east side of Fairlane Bridge	537	170	251	45.3	189	73.4	216	283	230	154	141	74	490	ND	102	390	3.3
Ditch into Tulpehocken Creek, east side of Fairlane Bridge	2,947																
Tulpehocken Creek, 450 feet east of plant	260																
Tulpehocken Creek, 1,000 feet east of plant	477										201		177				

TABLE 2-17
ARSENIC CONCENTRATIONS IN TULPEHOCKEN CREEK SEDIMENT SAMPLES
WHITMOYER LABORATORIES SITE
(mg/kg unless otherwise indicated)
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Site	Nov. 1964 (1)	May 1968 (1)	June 1969 (1,6,7)	Aug. 1969 (1)	Feb. 1970 (1,8)	July 1970 (1)	Aug. 1970 (1)	Sept. 1970 (1)	Nov. 1970 (1)	Jan. 1971 (1)	Spring 1972 (5,9)	Aug. 1972 (1)	Fall 1972 (5)	March 1980 (4)	Feb. 1984 (2)	July 1987 (2)	July 1987 (2,3)
Tulpehocken Creek at Race Street															47.5		
Tulpehocken Creek at College Street Bridge	81										117		162	ND			
Mill Creek upstream of Tulpehocken Creek confluence							1.2					4.3		ND			
Tulpehocken Creek at Womelsdorf Bridge		36.0	52.6	52.3	61.3	23.2	45.7	38.3	44.0	55.0	55	18.0	47				
Tulpehocken Creek 2 miles east of Bernville		29.0	48.5	24.6	17.1	9.4	22.3	21.5	44.0	12.0	29	3.9		ND			
Tulpehocken Creek 2 blocks before the Schuylkill River confluence		26.0	45.8	26.2	9.7	23.5	29.0	48.3	8.0	53.0		29.0					
Schuylkill River 2 blocks below Tulpehocken Creek confluence		4.0	2.5	4.2	0.8	2.9	2.1	8.5	4.3	4.2		2.8					
Schuylkill River 1 mile south of confluence		12.0	21.8	19.8	19.4	10.6	21.6	50.7	3.7	145.0		8.6					
Schyulkill River 200 yards before Pottstown		12.0	14.9	5.1	6.4	4.5	10.6	9.3	7.8	8.8		5.4					

ND Not detected
(1) WLI data
(2) USEPA TAT data
(3) EP toxicity data, mg/l
(4) PADER data (detection limit not specified)
(5) U.S. Army Corps of Engineers data
(6) Discharge of well water started in November 1968
(7) Well water discharge stopped temporarily in April 1969
(8) Well water discharge resumed in September 1969
(9) Well water discharge stopped permanently in March 1971

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Aquatic Biological Investigations

Four aquatic biological investigations of the Tulpehocken Creek benthos have been conducted by PADER since 1968. The first study, which occurred on June 18, 1968, contained a conclusion that a decrease in the number of benthic individuals and taxa occurred when comparing a station 1,050 feet upstream of the site (Ramona Road) with a downstream station (Fairlane Avenue). PADER concluded the decrease may be correlated with WLI effluents, runoff, or general stream habitat conditions.

On March 20 and 21, 1972, PADER representatives revisited the site. PADER concluded that good to excellent water quality conditions were present both upstream of the site and at the downstream Fairlane Avenue station. Two genera of pollution-sensitive mayfly larvae were observed at the Fairlane Avenue station.

A third aquatic biological investigation was conducted by PADER on December 19, 1974. Results indicated that the mayfly genus Ephemarella was present at the Ramona Road station, yet absent from the creek at all points sampled downstream of the site, including Fairlane Avenue. Possible explanations offered by PADER for this absence are unidentified spills which may have reached the creek, or arsenic presence in the creek.

A fourth PADER investigation was conducted on March 24, 26, and 27, 1980. Similar benthic conditions were noted when comparing the upstream Ramona Road station with the downstream Race Street station, with the exception that a pollution-sensitive caddisfly was not present at the downstream station. It was noted that although a small arsenic water concentration was noted (0.05 mg/l), the effect of agricultural runoff predominates at the Race Street station.

No arsenic was detected when sediment samples were collected from the stations along Tulpehocken Creek. The detection limit was not specified.

When a study for the USACE Blue Marsh Lake project was conducted by Rutgers University scientists in 1973, they predicted that biomagnification or accumulation of arsenic should not occur in the lake. As part of this study, aquatic samples were collected from Tulpehocken Creek and the nearby Little Swahara Creek. Although the arsenic concentrations in aquatic species was higher in Tulpehocken Creek than in the Little Swahara Creek, no evidence of arsenic accumulation was noted. In fact, lower arsenic concentrations were found at the higher trophic levels. These findings support additional studies which show that arsenic does not biomagnify or bioaccumulate to any significant degree.

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2.2.6 Usability of Data

While WLI was in the business of producing arsenic and aniline products and undoubtedly had professional laboratory capabilities, the quality of WLI data could not be identified. Few references to WLI analytical methodologies and quality assurance sample performances were found during data collection. Where references were found (e.g., see the sample split results from USGS and WLI presented in Table 2-6), precision performance was poor. One concern is that the WLI process samples typically analyzed by the WLI laboratory probably had arsenic, aniline, and PCE concentrations in the percent range, while environmental sample levels of concern are typically several orders-of-magnitude lower, in the ppb range. Laboratory inexperience with environmental samples and possible laboratory contamination could possibly have affected WLI data quality. Without supporting QA/QC data, it is impossible to evaluate the WLI data quality. Therefore, only USEPA TAT and ERT and PADER data will be considered for critical data uses for the RI/FS. The vast majority of this data is for arsenic and volatile organic compounds (VOCs) analyses from residential wells. This data appears to be of sufficient quality to be incorporated into the RI/FS.

With this available data base, only a limited number of residential wells will be sampled for arsenic and VOCs during the RI.

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3

3.0 SCOPING OF RI/FS

3.1 RI/FS OBJECTIVES

3.1.1 Preliminary Risk Assessment

3.1.1.1 Sources of Contamination

The Whitmoyer Laboratories Site formerly produced primarily animal pharmaceuticals. Contaminants associated with the site originated from the production or organic arsenicals and other pharmaceutical products. Wastewaters were disposed in unlined lagoons that were constructed directly on the fractured bedrock surface. When Whitmoyer Laboratories was purchased by Rohm & Haas in 1964, significant soil, surface water, and groundwater contamination was identified. Rohm & Haas constructed a large concrete vault to contain excavated lagoon sludges and other contaminated materials. Groundwater extraction was begun and local residents were supplied with bottled water if their wells were contaminated.

Previous sampling and analysis of environmental media by the property owners, PADER, and EPA indicated that there is residual contamination at the site. Surface and subsurface soils are known to contain up to 13,700 mg/kg arsenic. Groundwater both on and off site contains arsenic, solvents such as tetrachloroethene, and aniline. A large plume of arsenic emanates from the site.

Because of the variety of operations, feedstocks, and waste materials at the site, multiple sources of contamination were identified. At this time, it appears that the primary source areas at the site are the waste materials in the concrete vault; the lagoons containing arsenic sludges; process buildings, tanks, and drums; a waste pit; a cesspool; and a landfill. Arsenic is the major contaminant, but solvents and aniline were also found frequently. A discussion of the chemical characterization of the site is provided in Section 2.0.

3.1.1.2 Contaminant Migration Pathways

The major contaminant transport pathways with a potential for human or environmental exposure at the site are as follows:

- Contaminant leaching from source areas to the groundwater upon infiltration of precipitation. The relatively shallow depth to water and bedrock (less than 10 feet) promotes contaminant migration through the unsaturated zone, while a fractured bedrock aquifer allows rapid movements of contamination to surface water discharge points and receptor wells. Volatile organic compounds are most amenable to such transport. Arsenic may move either in solution or adsorbed to colloidal matter through the bedrock aquifer, depending on the environmental conditions.

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- Erosion of contaminated surface soils and dissolution of surficial soil contaminants, with subsequent transport to local water bodies in runoff. Arsenic and less-soluble contaminants such as the base/neutral extractables (e.g., coal tar components) are most likely to migrate off site adsorbed to particles.

- Wind erosion of contaminated surface soil may transport particulates off site. In instances where a site is vegetated or where wind patterns are broken up by buildings, such as the Whitmoyer Laboratories Site, this migration pathway is usually a minor component of contaminant transport.

3.1.1.3 Preliminary Risk Characterization

Groundwater

Analysis of groundwater from on site and off site monitoring wells, and off site residential wells, indicates the presence of volatile organic compounds (primarily monocyclic aromatics such as benzene and toluene, and chlorinated aliphatic hydrocarbons such as tetrachloroethene and 1,1,1-trichloroethane), base/neutral extractable compounds (such as aniline and naphthalene), and inorganics (such as arsenic). A number of offsite residential wells have been affected by the contaminant plume.

Although local residents are currently supplied with bottled water for drinking and cooking, they were previously exposed to potentially toxic levels of contaminants in their well water. In addition to the identified plume (of primarily arsenic), which was once 6 miles long and over 1 mile wide, arsenic is also found in Tulpehocken Creek and the Union Canal adjacent to the site. This contamination may have been transported by groundwater advection to these surface waters.

In the past, contamination has moved off site in all directions; therefore, persons residing in the area would be at risk from groundwater use. An extensive sampling program has identified contaminated wells, and local residents now receive alternate water supplies. Past risks cannot be accurately assessed because the exposure duration and past contaminant concentrations are not known. Current risks from consumption of groundwater can be estimated using the known contaminant concentrations.

Table 3-1 presents a summary of the estimated worst-case impacts of groundwater ingestion at the site. Risks were based on ingestion of 2 liters of water per day, over a 70-year lifetime,

TABLE 3-1

WORST-CASE ESTIMATED HEALTH IMPACTS
INGESTION OF GROUNDWATER/INGESTION OF SOILS (ARSENIC ONLY)
WHITMOYER LABORATORIES SITE

Chemical	Maximum Concentration (µg/l) (Unless Noted)	Adult Daily Dose mg/kg/day	Reference Dose (RfD)(1) mg/kg/day	Carcinogenicity Potency Factor(1) (CPF) kg-day/mg	Hazard Index	Estimated Lifetime Excess Cancer Risk
GROUNDWATER						
benzene	51	1.5×10^{-3}		5.2×10^{-2}		7.6×10^{-5}
toluene	14	4.0×10^{-4}	3.0×10^{-1}		1.3×10^{-3}	
chlorobenzene	14	4.0×10^{-4}	2.7×10^{-2}		1.5×10^{-2}	
ethylbenzene	62	1.8×10^{-3}	1.0×10^{-1}		1.8×10^{-2}	
tetrachloroethene	95,000	2.7	2.0×10^{-2}	5.1×10^{-2}	136	1.4×10^{-1}
trichloroethene	2,000	5.7×10^{-2}		1.1×10^{-2}		6.3×10^{-4}
cis-1,2-dichloroethene	43	1.2×10^{-3}				
trans-1,2-dichloroethene	6,000	0.17				
1,1-dichloroethene	4.7	1.3×10^{-4}	9.0×10^{-3}	5.80×10^{-1}	1.5×10^{-2}	7.8×10^{-5}
1,1,1-trichloroethane	537	1.5×10^{-2}	8.6×10^{-2}		1.8×10^{-1}	
1,1-dichloroethane	150	4.3×10^{-3}	1.2×10^{-1}	9.1×10^{-2}	3.6×10^{-2}	3.9×10^{-4}
1,2-dichloroethane	1.3	3.7×10^{-5}		9.1×10^{-2}		3.4×10^{-6}
methylene chloride	700	2.0×10^{-2}	6.0×10^{-2}	7.5×10^{-3}	3.3×10^{-1}	1.5×10^{-4}
chloroform	5	1.4×10^{-4}	1.0×10^{-2}	8.1×10^{-2}	1.4×10^{-2}	1.2×10^{-5}
phenol	130	3.7×10^{-3}	4.0×10^{-2}		9.3×10^{-2}	
aniline	9,230,000	264				

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TABLE 3-1
WORST-CASE ESTIMATED HEALTH IMPACTS
INGESTION OF GROUNDWATER/INGESTION OF SOILS (ARSENIC ONLY)
WHITMOYER LABORATORIES SITE
PAGE TWO

Chemical	Maximum Concentration (µg/l) (Unless Noted)	Adult Daily Dose mg/kg/day	Reference Dose (RfD)(1) mg/kg/day	Carcinogenicity Potency Factor(1) (CPF) kg-day/mg	Hazard Index	Estimated Lifetime Excess Cancer Risk
GROUNDWATER-Continued						
acenaphthene	2,000	5.7×10^{-2}				
fluoranthene	60	1.7×10^{-3}				
naphthalene	260	7.4×10^{-3}	4.1×10^{-1}		1.8×10^{-2}	
fluorene	1,200	3.4×10^{-2}				
phenanthrene	400	1.1×10^{-2}				
pyrene	80	2.3×10^{-3}				
arsenic	30,420,000	865	10×10^{-3}	1.5		$>10^{-1}$
SOILS						
arsenic	1,540,000 (µg/kg)	1.6×10^{-5}(2)		1.5		2.4×10^{-5}

(1) USEPA, 1986, revised November 1987
(2) Daily dose calculated for 45 kg child
(3) A Reference Dose has not been published for arsenic. 10 µg/kg/day is a NOAEL for inorganic arsenic cited in the draft "Toxicological Profile for Arsenic," Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, January 1988. 1-10 µg/kg/day may be beneficial to health according to the article. Note that the current EPA Drinking Water Health Advisory is 50 µg/l.

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for water containing the maximum identified contaminant concentrations. The table shows that arsenic and tetrachloroethene are the primary contributors to potential carcinogenic risk, whereas tetrachloroethene is most likely to cause toxic (noncarcinogenic) health effects.

Arsenic is known to cause skin lesions, peripheral vascular disease (blackfoot disease), and peripheral neuropathy in humans. The inorganic, trivalent form of arsenic is considered to be the most toxic. Lung and skin carcinomas have also been observed in persons ingesting 1.8 mg/l arsenic for 45 to 60 years.

Tetrachloroethene has been shown to induce liver tumors in mice upon oral exposure. The main target organs for toxic effects are the central nervous system, the liver, and the kidneys.

Surface/Subsurface Soils and Wastes

Waste materials exposed on site or contaminated surface soils may present a dermal or inhalational exposure risk to receptors such as site workers. Arsenic has been analyzed in soils, but because inorganics are not generally absorbed through the skin, the potential toxic effects cannot be estimated. In addition, the soils have not been characterized with respect to organic constituents, and therefore there may be an unquantified potential for exposure to site-related contaminants.

Subsurface soils, buried waste materials, or containerized wastes present no current risk to receptors. However, remediation activities such as drum removal or soil excavation would expose site workers to contamination via dermal contact or possibly by inhalation. The possibility that these materials may act as a source of additional environmental contamination will be addressed after they are characterized in the RI.

Surface Water and Sediments

Exposure to contaminants in surface water and sediment may occur in Tulpehocken Creek, the Union Canal, or any other surface water body receiving groundwater discharge that originates on site. Potential exposure routes include dermal contact, inhalation of volatilized contaminants, accidental ingestion, long-term ingestion of downstream surface water used as a potable supply source, or indirectly via ingestion in the food chain.

Insufficient data are presently available to estimate the potential for adverse health and environmental impacts associated with exposure to offsite surface waters. However, the levels of arsenic found in some surface-water samples near the site exceed drinking water standards. Contaminated groundwater probably discharges to Tulpehocken Creek and the Union Canal; arsenic was found in the water and sediments during the previous investigations. Additional information on contaminant loading to the Creek and Canal is needed to fully define the potential public health and environmental risks. Additional sampling and analysis of surface water and sediment is required to evaluate the potential for adverse health and environmental impacts associated with exposure to surface waters.

Exposure to contaminated sediments is also of concern at the site. Arsenic was detected in stream sediments, but no other parameters were analyzed for. Since contaminated surface soils may be eroded and transported to the creek or canal, there is the possibility of exposure. Arsenic may adsorb to and desorb from sediment and thus create a source for biota exposure, and indirectly, a human exposure.

Biota

Exposure to elevated arsenic through the ingestion of contaminated biota (fish) is a concern. Biota uptake of contaminants can occur as a result of exposure to contaminated surface waters and sediments. Sampling and analysis of surface water, sediment, and biota (fish) will be necessary to evaluate the significance of this exposure pathway.

Air

Receptors may be exposed to site-associated contaminants via the inhalation of air. Contaminants may enter the air as vapors that are volatilized from contaminated soils or wastes, or adsorbed to soil particulates that are transported by wind erosion. Exposure could potentially occur under baseline conditions and/or as a result of soil disturbances during site investigation or remedial actions.

Volatile organic vapors noted within site process buildings during the January 1988 site visit are a particular concern. Worker exposure to the volatile organic vapors will be evaluated by the Whitmoyer Site Health and Safety Officer before field activities within the process building commence.

The nature and extent of organic and inorganic contaminants in ambient air is unknown. Given the relatively high concentrations of arsenic in shallow soils, inhalation may be a major potential exposure pathway. Chronic inhalation exposure is of concern.

Summary

The preceding discussion identified the major routes of exposure to site contaminants and subsequent potential health and environmental concerns. Table 3-2 summarizes the present and potential site-specific public health and environmental risks associated with exposure to the various environmental media.

TABLE 3-2

SUMMARY OF PRELIMINARY RISK ASSESSMENT FOR THE WHITMOYER LABORATORIES SITE

Environmental Medium	Exposure Route	Risk(a)	
		Present	Potential
Groundwater	• Ingestion		X(b)
	• Inhalation (showering or other indoor activities)	X(c)	
	• Dermal contact	X(c)	
Surface Soil	• Dermal contact		X
Subsurface Soil and Wastes	• Dermal contact		X
	• Inhalation of volatilized contaminants		X
Surface Water	• Dermal contact		X
	• Inhalation of volatilized contaminants		X
	• Accidental ingestion	X	
	• Long-term ingestion	X	
	• Ingestion of contaminated biota	X	
Sediments	• Dermal contact		X
	• Ingestion of contaminated biota	X	
Air	• Inhalation	X	
	• Inhalation of fugitive dust or volatilized contaminants	X	

(a) Risk:
Present: Exposure route may exist, but risks may or may not exceed EPA criteria.
Potential: Based on the available data, exposure route does not exist at the present time; however, additional data or future activity may create this exposure route in the future.

(b) Exposure route existed in the past, but residents known to have contaminated wells are now supplied with bottled water.

(c) While residents have been supplied with bottled water for potable uses, well water is still used for non-potable uses.

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3.1.2 Risk Assessment Data Needs

This section summarizes the risk assessment data that are necessary in order to meet the risk assessment objectives for performing a RI/FS at the Whitmoyer Laboratories Site. The RI/FS objectives are detailed in Table 3-3.

Risk assessment data needs were identified by reviewing available existing data provided by the EPA, PADER and the potentially responsible parties (PRPs), and by conducting the preliminary risk assessment. The identification of data needs represents the second stage in the Data Quality Objective (DQO) Development Process following Stage I; identification of decision types. The risk assessment data needs for the Whitmoyer Site are derived from the need to accurately assess source-receptor relationships.

To perform a public health and environmental risk assessment for the Whitmoyer Site, it is necessary to characterize the following:

- The numerous hazardous materials/waste source areas for the type(s) and extent of contamination: vault, consolidated and excavated lagoons, process buildings, waste pits and cesspool, drum and tank storage areas, and other tentatively identified sources.
- Onsite and offsite groundwater, surface water, sediment and surficial and subsurface soils contamination.
- The present and potential transport of contaminants via groundwater and surface-water migration pathways.
- The leaching of contaminants into the groundwater.
- The present and potential mass loading of contaminants into the Union Canal, Tulpehocken Creek, and other area surface-water bodies (lakes, quarries).
- The extent of volatile organic airborne contamination in the vicinity of the vault and process buildings.

Data needs for implementing the outlined characterization for the site include the following:

- Sampling and analysis to determine the nature and extent (vertical and horizontal) of contamination in each of the source areas.
- Sampling and analysis to characterize contaminant migration from the source areas.

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TABLE 3-3

SCOPING MATRIX
WHITMOYER LABORATORIES SITE

Contaminant Source/Media/ Path	Suspected Contamination	Preliminary Risk Evaluation	ARARs	Potential Remedial Objectives	Remedial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Objectives: Risk	Data Objectives: Engineering
Source: Vault Potential Paths: Groundwater Direct Contact Air	Arsenic, Aniline, Solvents, Coal Tars, Phenols, Piperazine	Possibility of ground-water or air releases. Direct contact threat.	MCLs RCRA PADER Ch. 75 DOT OSHA NIOSH	Mitigate threat of groundwater and air releases and direct contact.	Risk MCLs RCRA PADER OSHA NIOSH	Containment Removal Onsite Treatment Onsite Disposal Offsite Treatment Offsite Disposal Shore up vault No action with monitoring	Capping Excavation and Removal Land Disposal Solidification Dissolution and Precipitation Grouting No action with monitoring Resource Recovery	Waste Concentrations Waste Leachability Effectiveness of Vault Seal Groundwater Levels Groundwater Concentrations Soil Concentrations around Vault Extent of Soil Contamination Air releases from Vault Flood Risk	Waste - Volume - Density - Treatability Vault Structural Status "Hazardous Waste" Determination Contaminated Soil - Volume - Density - Treatability

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TABLE 3-3
SCOPING MATRIX
WHITMOYER LABORATORIES SITE
PAGE TWO

Contaminant Source/Media/ Path	Suspected Contamination	Preliminary Risk Evaluation	ARARs	Potential Remedial Objectives	Remedial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Objectives	
								Risk	Engineering
Source: Consolidated Lagoons Potential Path: Groundwater	Arsenic, Coal Tars, Aniline, Solvents, Phenols, Piperazine	Possibility of ground-water contamina-tion	MCLs RCRA PADER Ch. 75 DOT OSHA	Mitigate threat of groundwater release	Risk MCLs RCRA PADER	Containment Removal Onsite Treatment Onsite Disposal Offsite Treatment Offsite Disposal No action with monitoring	Capping Excavation and Removal Land Disposal Solidification Slurry Wall (if liner) Vitrification No action with monitoring Resource Recovery	Sludge Concentrations Sludge Leachability Adjacent Soil Concentrations Adjacent Soil Leachability Extent of Soil Contamination Water Balance Groundwater Concentrations Groundwater Levels	Sludge - Volume - Density - Treatability Soil - Volume - Density - Treatability - Consolidation and Strength Characteristics "Hazardous Waste" Determination Cap Status - Thickness and Permeability Liner Status - Thickness and Permeability

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TABLE 3-3
SCOPING MATRIX
WHITMOYER LABORATORIES SITE
PAGE THREE

Contaminant Source/Media/ Path	Suspected Contamination	Preliminary Risk Evaluation	ARARs	Potential Remedial Objectives	Remedial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Objectives	
								Risk	Engineering
Source: Excavated Lagoons Potential Path: Groundwater	Arsenic, Coal Tars, Aniline, Solvents, Phenols, Piperazine	Possibility of ground-water contamina-tion	MCLs RCRA PADER Ch. 75 DOT OSHA	Mitigate threat of groundwater release	Risk MCLs RCRA PADER	Containment Removal Onsite Treatment Onsite Disposal Offsite Treatment Offsite Disposal No action with monitoring	Capping Excavation and Removal Land Disposal Solidification No action with monitoring	Sludge Presence Sludge Concentrations Sludge Leachability Adjacent Soil Concentrations Adjacent Soil Leachability Extent of Soil Contamination Groundwater Concentrations Groundwater Levels	Sludge Volume - Density - Treatability Soil - Volume - Density - Treatability "Hazardous Waste" Determination

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TABLE 3-3
SCOPING MATRIX
WHITMOYER LABORATORIES SITE
PAGE FOUR

Contaminant Source/Media/ Path	Suspected Contamination	Preliminary Risk Evaluation	ARARs	Potential Remedial Objectives	Remedial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Objectives	
								Risk	Engineering
Source: Process Bldgs. Potential Path: Direct Contact Air Groundwater Surface Water	Arsenic, p-Chloro-aniline, Aniline, Phenols, Piperazine, Coal Tars, Solvents, Asbestos	Direct contact threat. Possibility of air releases both inside and outside. Asbestos building materials may pose inhalation threat. Roof runoff, piping, sewer lines, and storm drains could pose threat to ground-water and surface water.	MCLs RCRA PADER Ch. 75 DOT OSHA NIOSH	Mitigate threat of direct contact and air, groundwater and surface water releases.	Risk MCLs RCRA PADER Asbestos laws OSHA NIOSH	Demolition Gutting Hydroblasting Sandblasting Washing Coating and Sealing Draining lines and drains No action with monitoring	Same as Potential Response Actions	Surface Deposit Concentrations Equipment Concentrations Air Concentrations Residual Liquids Concentrations and Volume Roof Runoff Concentrations Groundwater Levels Groundwater Concentrations Soil Concentrations Soil Leachability Building Surface Concentrations Building Subsurface Concentrations	Building Layout and Material Quantities Quantity of Equipment and Piping Soil Volume and Density "Hazardous Waste" Determination Treatability of Liquids, Building Materials, and Equipment Laboratory Wastes Concentrations and Volumes

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TABLE 3-3
SCOPING MATRIX
WHITMOYER LABORATORIES SITE
PAGE FIVE

Contaminant Source/Media/ Path	Suspected Contamination	Preliminary Risk Evaluation	ARARs	Potential Remedial Objectives	Remedial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Objectives: Risk	Data Objectives: Engineering
Source: Drums and Tanks Potential Paths: Direct Contact Air Groundwater Surface Water	Arsenic, p-Chloro-aniline, Aniline, Phenols, Piperazine, Coal Tars, Solvents	Threat of fire, explosion, direct contact and surface water, groundwater and air contamina-tion.	AWQC MCLs RCRA PADER Ch. 75 DOT OSHA NIOSH	Mitigate threats of fire, explosion, and direct contact and surface water, groundwater, and air contamination.	AWQC MCLs RCRA PADER OSHA NIOSH	Drum and Tank Removal Onsite Treatment Offsite Treatment Onsite Disposal Offsite Disposal	Drum and Tank Removal Onsite Treatment Offsite Treatment Bulking Onsite Disposal Offsite Disposal	Drum Concentrations Tank Concentrations Drum Solids Leachability	Drum and Tank Quantities and Volumes Drum Contents Bulkability "Hazardous Waste" Determination
Source: Waste Pits (Bldgs. 6, 9 and 11) Potential Path: Groundwater	Arsenic, Aniline, Solvents, Phenols, Coal Tars, Piperazine	Possibility of ground-water contamina-tion	MCLs RCRA PADER Ch. 75 DOT OSHA	Mitigate threat of groundwater contamination.	Risk MCLs RCRA PADER	Containment Removal Onsite Treatment Offsite Treatment Onsite Disposal Offsite Disposal No action with monitoring	Capping Excavation and Removal Solidification Onsite Landfilling Offsite Landfilling Washing Incineration No action with monitoring	Contaminant Concentration in Soils Building 6 Pit Status Depth to Groundwater Extent of Contamination Contaminant Leachability Groundwater Concentrations	Contaminated Soil - Volume - Density - Treat-ability "Hazardous Waste" Determination

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TABLE 3-3
SCOPING MATRIX
WHITMOYER LABORATORIES SITE
PAGE SIX

Contaminant Source/Media/ Path	Suspected Contamination	Preliminary Risk Evaluation	ARARs	Potential Remedial Objectives	Remedial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Objectives	
								Risk	Engineering
Source: 1951 Pit Potential Path: Groundwater	Arsenic, Aniline, Solvents, Phenols, Coal Tars, Piperazine	Possibility of groundwater contamination	MCLs RCRA PADER Ch. 75 DOT OSHA	Mitigate threat of groundwater contamination.	Risk MCLs RCRA PADER	Containment Removal Onsite Treatment Offsite Treatment Onsite Disposal Offsite Disposal No action with monitoring	Capping Excavation and Removal Solidification Onsite Landfilling Offsite Landfilling Washing Incineration Groundwater Pumping No action with monitoring	Contaminant Concentration in Soils Depth to Groundwater Extent of Contamination Contaminant Leachability Groundwater Concentrations Contaminant Concentration of Wastes (if any)	Contaminated Soil - Volume - Density - Treat-ability Waste (if any) - Volume - Density - Treat-ability "Hazardous Waste" Determination

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TABLE 3-3
SCOPING MATRIX
WHITMOYER LABORATORIES SITE
PAGE SEVEN

Contaminant Source/Media/Path	Suspected Contamination	Preliminary Risk Evaluation	ARARs	Potential Remedial Objectives	Remedial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Objectives	
								Risk	Engineering
Source: Photographic Anomalies Potential Paths: Direct Contact Air Groundwater Surface Water	Arsenic, Aniline, Piperazine, Coal Tars, Solvents, Phenols	Possibility of direct contact, surface-water contamination via runoff, and groundwater and air contamination	MCLs RCRA PADER Ch. 75 DOT OSHA AWQC NIOSH	Mitigate threat of direct contact, surface runoff, air release, and groundwater contamination.	Risk MCLs RCRA PADER AWQL NIOSH OSHA	Containment Removal Onsite Treatment Offsite Treatment Onsite Disposal Offsite Disposal Dust Suppressant No action with monitoring	Capping Excavation and Removal Solidification Onsite Landfilling Offsite Landfilling Washing Incineration Dust Suppressant No action with monitoring	Contaminant Concentrations in Soils Depth to Groundwater Extent of Contamination Contaminant Leachability Groundwater Concentrations Contaminant Concentrations of Wastes (if any)	Contaminated Soil - Volume - Density - Treat-ability Waste (if any) - Volume - Density - Treat-ability

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TABLE 3-3
SCOPING MATRIX
WHITMOYER LABORATORIES SITE
PAGE EIGHT

Contaminant Source/Media/ Path	Suspected Contamination	Preliminary Risk Evaluation	ARARs	Potential Remedial Objectives	Remedial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Objectives	
								Risk	Engineering
Source: Former DDAA Storage Piles Potential Paths: Direct Contact Air Groundwater Surface Water	Arsenic, Aniline, Piperazine, Coal Tars, Solvents, Phenols	Possibility of direct contact, surface water contamination via runoff, and groundwater and air contamination	MCLs RCRA PADER Ch. 75 DOT OSHA AWQC NIOSH	Mitigate threat of direct contact, surface runoff, air release, and groundwater contamination.	Risk MCLs RCRA PADER AWQC NIOSH OSHA	Containment Removal Onsite Treatment Offsite Treatment Onsite Disposal Offsite Disposal Dust Suppressant No action with monitoring	Capping Excavation and Removal Solidification Onsite Landfilling Offsite Landfilling Washing Incineration Dust Suppressant No action with monitoring	Contaminant Concentrations in Soils Depth to Groundwater Extent of Contamination Contaminant Leachability Groundwater Concentrations Contaminant Concentrations of Wastes (if any)	Contaminated Soil - Volume - Density - Treat-ability Waste (if any) - Volume - Density - Treat-ability

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TABLE 3-3
SCOPING MATRIX
WHITMOYER LABORATORIES SITE
PAGE NINE

Contaminant Source/Media/ Path	Suspected Contamination	Preliminary Risk Evaluation	ARARs	Potential Remedial Objectives	Remedial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Objectives	
								Risk	Engineering
Source: Drum Storage Areas Potential Paths: Direct Contact Air Groundwater Surface Water	Arsenic, Aniline, Piperazine, Coal Tars, Solvents, Phenols	Possibility of direct contact, surface water contamination via runoff, and groundwater and air contamination	MCLs RCRA PADER Ch. 75 DOT OSHA AWQC NIOSH	Mitigate threat of direct contact, surface runoff, air release, and groundwater contamination.	Risk MCLs RCRA PADER AWQC NIOSH OSHA	Containment Removal Onsite Treatment Offsite Treatment Onsite Disposal Offsite Disposal Dust Suppressant No action with monitoring	Capping Excavation and Removal Solidification Onsite Landfilling Offsite Landfilling Washing Incineration Dust Suppressant No action with monitoring	Contaminant Concentrations in Soils Depth to Groundwater Extent of Contamination Contaminant Leachability Groundwater Concentrations	Contaminated Soil - Volume - Density - Treat-ability

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TABLE 3-3
SCOPING MATRIX
WHITMOYER LABORATORIES SITE
PAGE TEN

Contaminant Source/Media/ Path	Suspected Contamination	Preliminary Risk Evaluation	ARARs	Potential Remedial Objectives	Remedial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Objectives	
								Risk	Engineering
Media: Onsite Soils Potential Paths: Direct Contact Air Groundwater Surface Water	Arsenic, Aniline, Coal tars, Hydrazine, phenols	Direct contact threat. Possibility of groundwater, surface water, and air contamination	AWQC MCLs RCRA PADER Ch. 75 DOT OSHA NIOSH	Mitigate threat of direct contact and groundwater, surface water, and air releases	AWQC MCLs RCRA PADER NIOSH OSHA	Containment Tilling Revegetation Removal Onsite Treatment Offsite Treatment Onsite Disposal Offsite Disposal No action with monitoring	Capping Tilling Revegetation Excavation and Removal Washing Solidification Onsite Land Disposal Offsite Land Disposal No action with monitoring	Surficial Soil Contaminant Concentrations Contaminant Leachability Air Concentrations Runoff Concentrations Prevailing Winds Extent of Contamination Background Concentrations	Surface Soil Volume, Density and Treatability Subsurface Soil Volume, Density and Treatability "Hazardous Waste" Determination Groundwater Levels Groundwater Concentrations

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TABLE 3-3
SCOPING MATRIX
WHITMOYER LABORATORIES SITE
PAGE ELEVEN

Contaminant Source/Media/ Path	Suspected Contamination	Preliminary Risk Evaluation	ARARs	Potential Remedial Objectives	Remedial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Objectives	
								Risk	Engineering
Media: Offsite Soils Potential Paths: Direct Contact Air Groundwater Surface Water	Arsenic, Aniline,	Direct contact threat. Possibility of ground- water surface water, and air con- tamination	AWQC MCLs RCRA PADER Ch. 75 DOT OSHA NIOSH	Mitigate threat of direct contact, and ground water, surface water and air releases	AWQC MCLs RCRA PADER NIOSH OSHA	Containment Tilling Revegetation Removal Onsite Treatment Offsite Treatment Onsite Disposal Offsite Disposal No action with monitoring	Capping Tilling Revegetation Excavation and Removal Washing Solidification Onsite Land Disposal Offsite Land Disposal No action with monitoring	Surficial and Subsurface Soil Contaminant Concentrations Contaminant Leachability Air Concentrations Runoff Concentrations Prevailing Winds Extent of Contamination Background Concentrations	Surface Soil Volume, Density and Treat- ability Subsurface Soil Volume, Density and Treatability "Hazardous Waste" Determination Soil Attenuation Capacity

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TABLE 3-3
SCOPING MATRIX
WHITMOYER LABORATORIES SITE
PAGE TWELVE

Contaminant Source/Media/ Path	Suspected Contamination	Preliminary Risk Evaluation	ARARs	Potential Remedial Objectives	Remedial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Objectives	
								Risk	Engineering
<u>Media</u>: Onsite Soils (Subsurface) Potential Path: Groundwater	Arsenic, Aniline, Solvents, Coal Tar, Piperazine, Phenols	Possibility of ground-water con-tamination from desorption	MCLs RCRA PADER Ch. 75 DOT OSHA	Mitigate threat of groundwater contamination	MCLs RCRA PADER Risk	Containment Removal Onsite Treatment Offsite Treatment In-situ Treatment Onsite Disposal Offsite Disposal Groundwater Level Lowering No action with monitoring	Capping Excavation Landfilling Solidification Washing Pumping In-situ Washing No action with monitoring	Soil Concentrations Groundwater Levels Extent of Contamination Background Concentrations	Soil Volume, Density, and Treatability "Hazardous Waste" Determination

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TABLE 3-3
SCOPING MATRIX
WHITMOYER LABORATORIES SITE
PAGE THIRTEEN

Contaminant Source/Media/ Path	Suspected Contamination	Preliminary Risk Evaluation	ARARs	Potential Remedial Objectives	Remedial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Objectives	
								Risk	Engineering
Media: Offsite Soils (Subsurface) Potential Paths: Direct Contact Groundwater Surface Water Air	Arsenic, Aniline, p-chloroaniline Solvents, Coal Tar, Piperazine, Phenols	Possibility of ground water contamination from desorption	MCLs RCRA PADER Ch. 75 DOT OSHA	Mitigate threat of ground water contamination	MCLs RCRA regulations PADER regulations Risk	Containment Removal Onsite Treatment Offsite Treatment In situ Treatment Onsite Disposal Offsite Disposal Groundwater Level Lowering No action with monitoring	Excavation Landfilling Solidification Washing Pumping In-situ Washing No action with monitoring	Soil concentrations Groundwater Levels Extent of Contamination Background Concentrations	Soil Volume, Density and Treatability "Hazardous Waste" Determination

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TABLE 3-3
SCOPING MATRIX
WHITMOYER LABORATORIES SITE
PAGE FOURTEEN

Contaminant Source/Media/Path	Suspected Contamination	Preliminary Risk Evaluation	ARARs	Potential Remedial Objectives	Remedial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Objectives	
								Risk	Engineering
Media: Surface Water & Sediment	Arsenic, Aniline, Solvents, Coal Tars, Piperazine, and Phenols	Contaminants may threaten downstream fishing, recreation, and drinking-water uses and aquatic organisms	MCLs RCRA PADER Ch. 75 DOT OSHA	Mitigate threat from fishing, recreation, and drinking water uses and aquatic organisms	AWQC MCLs RCRA PA Water Quality Standards	Source Controls Groundwater Pump and Treat Surface Runoff Collection Surface Runoff Diversion Sediment Removal Onsite Treatment (Runoff and/or Sediments) Onsite Disposal (Sediments) Offsite Disposal (Sediments) No Action with Monitoring	Capping Erosion and Sedimentation Control Grading Excavation and Removal Solidification Precipitation Washing Onsite Land Disposal Offsite Land Disposal No Action with Monitoring	Surface Water Concentrations (Background and Downstream) Sediment Concentrations (Background and Downstream) Extent of Contamination Surface Runoff Concentrations Biota Concentrations Biota Inventory Groundwater Discharge Concentrations User Inventory	Contaminated Sediment Volume, Density, and Treatability Stream Flow Surface Runoff Volume Groundwater Discharge Volume

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TABLE 3-3
SCOPING MATRIX
WHITMOYER LABORATORIES SITE
PAGE FIFTEEN

Contaminant Source/Media/Path	Suspected Contamination	Preliminary Risk Evaluation	ARARs	Potential Remedial Objectives	R.medial Cleanup Criteria	Potential Response Actions	Potential Remedial Technologies	Data Objectives	
								Risk	Engineering
Media: Groundwater	Arsenic, Solvents, Coal Tars, Piperazine, Phenols	Contaminated groundwater poses threat to users and also threat of discharge to surface water.	MCLs RCRA PADER Ch. 75 DOT OSHA	Mitigate threat of ground water use and discharge to surface water	AWQC MCLs RCRA PA Water Quality Standards	Source Controls Pump and Treat Biodegradation Aquifer Washing In Situ Treatment No Action with Monitoring	Source Controls Pumping Flocculation/ Precipitation Carbon Columns Air Stripping Biodegradation Aquifer Washing In-Situ Precipitation No Action with Monitoring	Groundwater Contaminant Concentrations Plume Dimensions User Inventory Background Concentrations	Groundwater Flow Direction and Rate Groundwater Treatability Plume Dimensions and Volume In-Situ Precipitation Data Aquifer Washing Data Biodegradation Data

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- Sampling and analyses to characterize onsite/offsite contamination of groundwater, surface water, sediment, and surficial and subsurface soils.

- Sampling and analysis to characterize contamination in offsite sediments.

- Biomonitoring to determine whether the site is affecting benthic communities in Tulpehocken Creek.

- Sampling and analysis to determine the nature and extent of site contaminants (arsenic) in aquatic biota and subsequent health and environmental impacts.

- Wetlands delineation study to identify wetlands potentially affected by site contaminants.

- Identification and characterization of receptors at risk.

The data needs discussed in this section are detailed further on Table 3-3.

3.1.3 Preliminary Scoping of Remedial Technologies

The general environmental problems associated with the Whitmoyer Laboratories Site include the presence of concentrated arsenical wastes in the lagoons and vault; drums and tanks potentially containing concentrated wastes; possibly contaminated buildings, equipment and piping; potential hot spots of heavily contaminated soils (and possibly buried wastes, including drums) on site, known contamination of on and offsite soils and groundwater, and the possibility of surface water and sediment contamination. A broad spectrum of remedial technologies has been developed to provide a preliminary list of remedial alternatives and focus engineering data acquisition. These technologies are listed in Table 3-1. The identified remedial technologies are those which have been selected as potentially capable of mitigating the present and potential public health and environmental exposure routes and contaminant pathways to acceptable levels.

Since the historical data indicates that both the lagoon sludge and vault contents have elevated contaminant concentrations, and since it is desirable to develop remedial alternatives as early as possible in the RI/FS process, applicable technologies for the sludge and vault contents are being screened concurrent with development of this Work Plan. Technologies remaining after screening will be combined into alternatives. Treatment alternatives will be developed, to the degree possible, that would eliminate the need for long-term management at the site and that would reduce toxicity, mobility, or volume as their principal element, in accordance with the Superfund Amendments and Reauthorization Act (SARA). If promising yet unproven treatment technologies are identified during screening, treatability tests will be designed and treatability testing initiated.

For the remainder of the wastes and media identified at the Whitmoyer Laboratories Site, the screening of technologies and the identification of innovative technologies will begin shortly after approval of the project plans. As the RI progresses, additional screening and identification of other technologies will occur (the screening criteria are discussed in Section 5.0). As above, technologies remaining after screening will be combined into alternatives, and treatability testing will be initiated on the most promising alternatives, if warranted.

Since the lagoon sludge and vault contents are known to be contaminated, the modified Work Plan budget included provisions to research and identify treatability studies and develop treatability study specifications for these wastes. Additional funding has been requested to carry out treatability studies for these and other wastes, e.g., groundwater, at the Whitmoyer Laboratories Site. Since it is impossible to predict the scope of any treatability studies at this point, the REM III team has asked that a resource pool be set aside to facilitate these studies when they are identified. If a need to research and identify treatability studies for the other wastes, and/or to implement treatability studies, is identified, request to use the resource pool will be presented to EPA for approval.

3.1.4 Engineering Data Gaps

This section summarizes the data necessary to provide sufficient engineering information for performing a remedial investigation and feasibility study at the Whitmoyer Site. Once the preliminary remedial technologies presented in Section 3.1.3 above were compiled and broken down into remedial alternatives, the existing data base was reviewed, and data needs to evaluate the feasibility of remedial alternatives identified. These data needs are presented in Table 3-3.

The identification of the engineering data requirements (along with the public health and environmental risk data needs developed above) represent the second stage in the Data Quality Objective (DQO) development process. Once the data requirements are developed, field sampling activities can be identified, which will result in the acquisition of the required data. DQOs are then developed, which will detail the appropriate quantity and quality of required data.

3.2 IDENTIFICATION OF DATA REQUIREMENTS

3.2.1 Determination of Applicable or Relevant and Appropriate Requirements (ARARs)

One of the primary concerns in the development of remedial action alternatives for sites governed by the Comprehensive

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Environmental Response, Compensation, and Liability Act (CERCLA) is the degree of public health or environmental protection afforded by each remedy. EPA policy states that in the process of developing and selecting remedial action alternatives, primary consideration should be given to actions that attain or exceed Applicable or Relevant and Appropriate Requirements (ARARs), as defined by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as amended by the Superfund Amendments and Reauthorization Act (SARA). The purpose of this requirement is to make CERCLA response actions consistent with other pertinent Federal and state environmental requirements. ARARs must be identified for each site.

SARA defines an ARAR as

- Any standard, requirement, criterion, or limitation under Federal environmental law.

- Any promulgated standard, requirement, criterion, or limitation under a state environmental or facility siting law that is more stringent than the associated Federal standard, requirement, criterion, or limitation.

Applicable requirements are those Federal and state requirements that would be legally applicable to a remedial action if that action were not undertaken pursuant to CERCLA. For example, if hazardous waste activities were undertaken pursuant to an approved permit, applicable regulations would be available to legally define the required remedial action for site closure. Relevant and appropriate requirements are those Federal and state public health and environmental requirements that apply to circumstances sufficiently similar to those encountered at CERCLA sites, wherein their application would be appropriate although not legally required. Relevant and appropriate requirements are intended to carry the same weight as applicable requirements. EPA has also indicated that "other" criteria, advisories, and guidelines must be considered in devising remedial alternatives.

Section 121 of SARA requires that the remedy for a CERCLA site must attain all ARARs unless one of the following conditions is satisfied: (1) the remedial action is an interim measure whereby the final remedy will attain the ARAR upon completion; (2) compliance will result in greater risk to human health and the environment than other options; (3) compliance is technically impracticable; (4) an alternative remedial action will attain the equivalent of the ARAR; (5) for state requirements, the state has not consistently applied the requirement in similar circumstances; or (6) compliance with the ARAR will not provide a balance between protecting public health, welfare, and the environment at the facility with the availability of Fund money for response at other facilities (Fund-balancing). In addition to governing response actions at a site, ARARs may also dictate other aspects of the remedial investigation/feasibility study. For example, some of the

Maximum Contaminant Levels (MCLs) promulgated under the Safe Drinking Water Act (SDWA) are below the Contract-Required Detection Limits of the USEPA's Contract Laboratory Program. Thus, routine analytical services may be inadequate to indicate compliance or exceedance of the ARAR. Therefore, it is often necessary that ARARs be considered during the specification of chemical-analytical methods. In light of such concerns, ARARs will be considered at four points during the RI/FS process: (1) Field Investigation (Task 3); (2) Public Health and Environmental Assessment (Task 6); (3) Remedial Alternatives Screening (Task 9); and (4) Remedial Alternatives Evaluation (Task 10).

ARARs fall into three broad categories, based on the manner in which they are applied at a site. These categories are as follows:

- Contaminant Specific - These ARARs govern the extent of site cleanup. Such ARARs may be actual concentration-based cleanup levels or they may provide the basis for calculating such levels.

- Location Specific - These ARARs are considered in view of natural or manmade site features. Examples of natural site features include wetlands, scenic rivers, and floodplains. Manmade features could include, for example, the presence of historic districts. ARARs based on aquifer designations are also location-specific ARARs.

- Action Specific - These ARARs pertain to the implementation of a given remedy. Examples of action-specific ARARs include monitoring requirements, effluent discharge limitations, hazardous waste manifesting requirements, and occupational health and safety requirements.

A detailed list of the preliminary Federal and Commonwealth of Pennsylvania ARARs identified for the Whitmoyer Laboratories Site is included in Appendix A. The ARARs will be evaluated in terms of their applicability, relevance, and appropriateness to each of the remedial action alternatives under consideration for the site.

The effects of each remedial alternative on groundwater will be assessed to determine compliance with ARARs. Table 3-4 provides a comparison of maximum contaminant concentrations detected in the groundwater under existing conditions to applicable water quality standards and criteria.

The effects of remedial alternatives on air quality will be assessed to determine compliance with applicable state and Federal regulations. For example, onsite activities will have to comply with ambient-air-quality standards regulated under the Clean Air Act (sulfur dioxide, nitrogen oxides, carbon monoxide,

TABLE 3-4

COMPARISON OF MAXIMUM CONTAMINANT CONCENTRATIONS IN GROUNDWATER
WITH APPLICABLE WATER STANDARDS AND CRITERIA
WHITMOYER LABORATORIES SITE

Site Contaminant	Maximum Concentration (µg/l)	NPDWR (µg/l)				EPA Drinking Water Health Advisories (µg/l)					Ambient Water Quality Criteria			
											Aquatic Life (µg/l)		Human Health (µg/l)	
		MCL	PMCL	MCLG	PMCLG	1-day Child	10-day Child	Longer-term Child	Longer-term Adult	Lifetime Adult	Acute	Chronic	Ingestion of Drinking Water and Aquatic Life	Ingestion of Drinking Water
acetone														
benzene	51	5		0		235	235				5,300		0(0.66)	0(0.67)
toluene	14				2,000	18,000	6,000			10,800	17,500		14,300	15,000
chlorobenzene	14					1,800	1,800	9,000	30,000	3,150				
ethylbenzene	62				680	21,000	2,100			3,400	32,000		1,400	2,400
styrene					140	22,500	2,000	2,000	7,000	140				
xylenes					440	12,000	7,800	7,800	27,300	2,200				
tetrachloroethene	95,000				0		34,000	1,940	6,800		5,280	840	0(0.8)	0(0.88)
trichloroethene	2,000	5		0						260	45,000	21,900	0(2.7)	0(2.8)
cis-1,2 dichloroethene	43				70	4,000	1,000	1,000	3,500	350	11,600			
trans-1,2-dichloroethene	6,000				70	2,720	1,000	1,000	3,500	350	11,600			
1,1-dichloroethene	4.7					2,000	1,000	1,000	3,500	7			0(33 ng/l)	0(33 ng/l)
1,1,1 trichloroethane	537	200		200		140,000	35,000	35,000	125,000	200	18,000		18,400	19,000

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TABLE 3-4
COMPARISON OF MAXIMUM CONTAMINANT CONCENTRATIONS IN GROUNDWATER
WITH APPLICABLE WATER STANDARDS AND CRITERIA
WHITMOYER LABORATORIES SITE
PAGE TWO

Site Contaminant	Maximum Concentration (µg/l)	NPDWR (µg/l)				EPA Drinking Water Health Advisories (µg/l)					Ambient Water Quality Criteria			
											Aquatic Life (µg/l)		Human Health (µg/l)	
		MCL	PMCL	MCLG	PMCLG	1-day Child	10-day Child	Longer-term Child	Longer-term Adult	Lifetime Adult	Acute	Chronic	Ingestion of Drinking Water and Aquatic Life	Ingestion of Drinking Water
1,1 dichloroethane	150													
1,2-dichloroethane	1.3					740	740	740	2,600		118,000	20,000	0(0.94)	0(0.94)
methylene chloride	700					13,300	1,500				11,000		0(0.19)	0(0.19)
chloroform	5										28,900	1,250	0(0.19)	0(0.19)
carbon disulfide														
phenol	130										10,200	2,560	3,500	3,500
aniline	9,230,000													
acenaphthene	2,000										1,700		20	20
fluoranthene	60										3,980		42	188
naphthalene	260										2,300	620		
fluorene	1,200													
phenanthrene	400													
pyrene	80													
p chloroaniline														

300210

TABLE 3-4
COMPARISON OF MAXIMUM CONTAMINANT CONCENTRATIONS IN GROUNDWATER
WITH APPLICABLE WATER STANDARDS AND CRITERIA
WHITMOYER LABORATORIES SITE
PAGE THREE

Site Contaminant	Maximum Concentration (µg/l)	NPDWR (µg/l)				EPA Drinking Water Health Advisories (µg/l)					Ambient Water Quality Criteria			
											Aquatic Life (µg/l)		Human Health (µg/l)	
		MCL	PMCL	MCLG	PMCLG	1-day Child	10-day Child	Longer-term Child	Longer-term Adult	Lifetime Adult	Acute	Chronic	Ingestion of Drinking Water and Aquatic Life	Ingestion of Drinking Water
arsenic	30,420,000	50				50	50	50	50	50	III-140 V-850	III-72	0(2.2ng/l)	(25 ng/l)
antimony														
barium		1,000								1,800				
cadmium		10				43	8	5	18	18	2.0(a)	2.0(a)	10	10
mercury		2								5.5	1.1	0.20	144 ng/l	10
selenium		10									260	35	10	10
silver		50									1.2(a)	0.12	50	50
tin														
zinc											180(a)	47	5,000	5,000
cyanide						220	220	220	750	750	22	4.2	200	200

(a) at 50 mg/l hardness
( ) = 10^{-6} risk

NPDWR National Primary Drinking Water Regulations
MCL Maximum Contaminant Level
PMCL Proposed Maximum Contaminant Level
MCLG Maximum Contaminant Level Goal
PMCLG Proposed Maximum Contaminant Level Goal

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ozone, particulate matter, and lead). Any incineration technologies will have to comply with applicable emission regulations.

The effects of implementing the remedial alternatives on terrestrial and aquatic species will have to be evaluated to ensure compliance with applicable rules and regulations pertaining to fish and wildlife and endangered species.

3.2.2 Data Quality Objectives (DQO)

The Whitmoyer Laboratory Site RI/FS objectives and risk assessment and engineering data needs were discussed in preceding sections. Table 3-5 summarizes the various data collection activities proposed to meet the data needs and the objectives of the RI/FS and states the purpose and end use of the data. A detailed description of the RI/FS data collection program is provided by Tables 3-3, 3-5, and 3-6 and is discussed in subsequent sections.

The design of a data collection program is the third and final stage of the Data Quality Objective (DQO) process (USEPA, 1987).

DQOs are a statement of the quality of data needed to support a specific decision or action. Specifically, DQOs are established to ensure that the data collected are sufficient and of adequate quantity and quality for their intended uses (USEPA, 1987). Table 3-5 focuses on why certain data are being collected and how the data will be used. However, this section does not document the PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters. The PARCC parameters are discussed in the Whitmoyer Laboratories Site Field Operations Plan (FOP).

3.3 SCOPING OF REMEDIAL INVESTIGATION

Section 3.3 presents the technical approach proposed for the remedial investigation (RI) at the Whitmoyer Laboratories Site. Data needs are summarized and the field activities planned to address identified data gaps are described. The overall RI field investigation is presented as a series of individual investigations, each designed to address a particular potential source of contamination or other concern identified. This approach has been taken so that the rationale and the technical approach for the proposed activities can be presented and evaluated in a more concise, focused manner. The large number of potential source areas and other concerns identified at the site make a single, overall description of the field investigation difficult to describe adequately for both evaluation and planning purposes.

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TABLE 3-5

INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Vault							
Waste Concentrations		Extend two borings into vault materials through roof. Collect two samples per boring, one of calcium arsenate sludge, and one of dirt and drum leakage above sludge.	2 roof locations.	4: 2 per boring 2: 1 per boring	Laboratory Laboratory	TCL - Volatiles TCL(BNAs) & Aniline TAL Cyanide TCL-Pesticides/PCBs	V V V V V
Waste Leachability	"Hazardous Waste" Determination	Subject splits of waste samples for TCLP analyses.		4 samples	Laboratory	TCLP (Metals)	III
	Waste Volume	The waste volume will be estimated by incorporating the vault dimensions and the waste thickness.					
	Waste Density	The vault material's density will be estimated from the literature.					
	Treatability of Calcium Arsenate Sludge	Sample sludge from vault borings and subject to treatability tests, if warranted.		2: Bulk samples	Laboratory	To be determined	
Vault Contact with Environment		Inject tracer through a well point installed to base of vault. Place 4 monitor wells at 3 locations for chemical sampling and tracer detection. Look for tracer in two downgradient shallow monitoring wells following injection.	3 shallow wells around perimeter of vault	29 (Sample 3 shallow wells once prior to injection and 2 downgradient wells once a week for 13 weeks following injection.)	Laboratory	Lithium	III

300213

TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE TWO

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Vault (Continued)							
Groundwater Level		Measure water levels in well point, draw tubes, monitor wells, Kohl borehole, and Union Canal, and compare to see if fluctuations correlate.	Well point, draw tubes, monitor wells, Kohl borehole, and Union Canal	At least 2 rounds	Field	Water Level	I
Groundwater Concentrations		Sampling of monitoring wells; both filtered and unfiltered metals samples will be collected.	4 monitoring wel', at 3 locations	8: 4 wells x 2 rounds	Laboratory	TCL (VOAs) TCL(BNAs) & Aniline TOC, COD, BOD As, Fe (2nd Round)	IV V III IV
				4: 1st round only	Laboratory	TAL Common Anions Total Alkalinity	IV III III
			1 Downgradient well	1: 1st round only	Laboratory	PCB/Pesticides Cyanide	IV IV
				8 samples	Field Measurement	pH Conductivity Dissolved Oxygen Eh Temperature	I I I I I
Vault Structural Status		Visual observation of vault walls for signs of deterioration.			Visual		

TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE THREE

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Vault (Continued)							
Extent of Soil Contamination Soil Concentrations Around Vault	Contaminated Soil Volume	Sample soil borings, which will be drilled adjacent to well locations, at specified intervals.	3 boring sites	6: 3 borings x 2 samples/boring (top 3 inches, and one sub-surface sample)	Laboratory	Arsenic, Iron	IV
			2 selected samples	2: soil-bedrock contact samples	Laboratory	TCL (VOAs) TAL TCL(BNAs) & Aniline	IV IV V
Adjacent Soil Leachability	"Hazardous Waste" Determination	Submit 1 subsurface sample per every other perimeter boring for TCLP (metals) analysis.		2: 1 per every other boring		TCLP (metals only)	III
	Soil Density	Estimate soil density from the literature.					
Flood Risk		Review floodplain records					
	Contaminated Soil Treatability	If warranted, treatability studies will be initiated at a later date.					

300215

TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE FOUR

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Consolidated Lagoons							
Sludge Concentrations	Sludge Volume	Stratified sampling with soil borings. Sample continuously with split spoon (or Shelby tube). Collect 1 sample of surface material (0-3 inches); 1 from western lagoon sludge, and 1 from original eastern lagoon sludge. Analyze samples as shown on right.	1 site per lagoon for lagoons 5-12	16: 8 holes x 2 samples/hole	Laboratory	Arsenic, Iron Aniline	V V
				8: 8 holes x 1 subsurface sample/hole		TCL (VOAs) TAL TCL(BNAs) & Aniline	V V V
			2 selected holes	6: 2 holes x 3 samples/hole		Pesticides/PCBs Cyanide Eh, pH	V V III
Sludge Leachability	"Hazardous Waste" Determination	Subject 1 of 2 subsurface samples per boring to a TCLP test for metals.	8 boring locations	8: 1 per boring	Laboratory	TCLP (Metals)	III
Sludge Leachability		Install 4 lysimeters in unsaturated sludge and sample twice.	1 per lagoon	8: 4 lysimeters x 2 rounds	Laboratory Field	Arsenic, Iron pH	IV I
		Subject 4 samples each of sludge material to permeability tests.	4 lagoon sites	4 samples	Laboratory	Triaxial Permeability and/or Grain Size	III
	Sludge Density	Subject 4 samples of sludge material to laboratory density tests.	4 boring locations	4 samples	Laboratory	Unit Weight Specific Gravity	III III

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TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE FIVE

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Consolidated Lagoons (Continued)							
	Sludge consolidation and strength characteristics	Subject 4 samples of sludge material to laboratory consolidation and strength characteristics tests.	4 distributed across site	4 samples	Laboratory	One-dimensional consolidation and unconfined compressive strength or Atterberg limits	III
	Sludge Treatability	Collect Shelby tubes or split spoons for tests on non-sample intervals. If deemed necessary, conduct treatability tests.	8 holes		Laboratory	To be determined	
	Cap Thickness and Permeability	Visual observation during drilling. Submit selected Shelby tubes for laboratory permeability tests.	4 distributed across site	4 samples	Laboratory	Triaxial Permeability and/or Grain Size	III
	Liner Thickness and Permeability	Visual observation during drilling.	4 distributed across site	4 samples	Visual	Triaxial Permeability and/or Grain Size	III
Adjacent Soil Concentrations Extent of Soil Contamination	Soil Volume	Drill 5 additional perimeter boreholes to confirm lagoon limits and measure depth to bedrock.	5 holes around perimeter	10: 5 holes x 2 samples/ hole 3: 1 subsurface sample/every other hole 1: subsurface sample	Laboratory	Arsenic, Iron TCL (VOAs) TAL TCL(BNAs) & Aniline Pesticides/PCBs Cyanide	IV IV IV V IV IV

300217

TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE SIX

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Consolidated Lagoons (Continued)							
Adjacent Soil Leachability	"Hazardous Waste" Determination	Submit 1 subsurface sample per every other perimeter boring for TCLP (metals only) analysis.		3: 1 per every other boring		TCLP (Metals only)	III
	Water Balance	Estimate P, E, T			Literature Survey		
Groundwater Concentrations		Install 4 monitoring wells around lagoon perimeter. Collect two rounds of samples per well.	4 monitoring well locations around lagoon perimeter	8: 4 wells x 2 rounds	Laboratory	TCL (VOA)	IV
						TCL(BNAs) & Aniline	V
						TOC, COD, BOD	III
				4:	Laboratory	TAL (1st Round)	IV
				4:		As, Fe (2nd Round)	IV
				4:		Common Anions (1st Round)	III
				4:		Total Alkalinity (1st Round)	III
				1:	Laboratory	Pesticides/PCBs	IV
						Cyanide	IV
				8: 4 wells x 2 rounds	Field Measurement	pH	I
						Conductivity	I
						Eh	I
						Temperature	I
						Dissolved Oxygen	I
Groundwater Levels		Take at least 2 rounds of groundwater level measurements from monitoring wells.			Field Measurement	Water Levels	I

300218

TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE SEVEN

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Excavated Lagoons							
Sludge Presence	Sludge Volume	Excavate two test pits or borings per former lagoon and visually assess for sludge presence.	14 test pits in former lagoon locations	14 samples	Visual		
Sludge Concentrations	"Hazardous Waste" Determination	Sample only one excavation per lagoon. Collect 1 surface sample and 1 subsurface sample from the one excavation sampled per lagoon. Collect an additional sample from 4 excavations and analyze for TCL, TCLP (metals) and TAL (metals). If sludge is present, sample it as one of the four samples. If no sludge is present, collect the samples from the soil-bedrock interface.	7 former lagoon locations	4 selected samples	Laboratory	TAL TCL (VOAs) TCL(BNAs) & Aniline TCLP (Metals)	IV IV V III
			7 former lagoon locations	14: 7 pits x 2 samples/pit	Laboratory	Arsenic, Iron	IV
Adjacent Soil Concentrations	Soil Volume	Place 3 test pits around lagoon perimeter. Collect a surface sample at 0-3 inches and 1 subsurfaces sample. Analyze 1 additional subsurface sample from every other pit for TCL, TAL, and TCLP.	3 sites around lagoon perimeter	6: 3 pits x 2 samples/pit	Laboratory	Arsenic, Iron	IV
	"Hazardous Waste" Determination			2 selected samples	Laboratory	TCL (VOA), TAL TCL(BNA) & Aniline TCLP (Metals)	IV V III
	Soil Density	Estimate soil density from the literature.					

300213

TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE EIGHT

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Excavated Lagoons (Continued)							
	Soil Treatability	If significant soil contamination is found, the need for treatability tests will be assessed.					
Groundwater Concentrations		Install 3 monitoring wells around lagoon perimeter.	3 perimeter sites around excavated lagoons	6: 3 samples/round x 2 rounds 3: 1st round only 3: 2nd round only 6: 3 samples/round x 2 rounds	Laboratory Laboratory Field Measurement	TCL (VOA) TOC, COD, BOD TCL(BNAs) & Aniline Common Anions Total Alkalinity TAL As, Fe pH Eh Conductivity Dissolved Oxygen Temperature	IV III V III IV IV IV I I I I I
Groundwater Levels		Collect at least 2 rounds of groundwater levels from monitoring wells.	Monitoring well locations		Field Measurement	Water Levels	I

300220

TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE NINE

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Process Buildings							
Concentrations of Surficial Deposits		Wipe sample of surficial solids on walls, ceilings, and floors.	1 per room-wall	100 (est.) 1 per wall	Laboratory	Arsenic TCL(BNAs) & Aniline	IV V
		Note: The number of rooms is not yet known.	1 per room-floor	1 per floor			
			1 per room-roof	1 per roof-site			
		Wipe samples of solids concentrations near building exhausts.		6 (est.)	Chemical	Arsenic TCL(BNAs) & Aniline	IV V
	Building Material Quantities	Visual Inventory	All buildings		Visual		
	Building Layout	Visual Inspection. Count the number of rooms.	All buildings		Visual		
	Quantity of Equipment and Piping	Visual Inventory					
Equipment concentrations		Composite wipe samples from several pieces of equipment		50 (est.)	Chemical	Arsenic TCL(BNAs)& Aniline	IV V

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TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE TEN

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Process Buildings (Continued)							
Air Concentrations		Volatiles monitoring for most chemicals using an HNU. Measure aniline and methyl bromide levels with NIOSH protocols in rooms where their presence is suspected.		1 per suspected room	Laboratory	Aniline Methyl Bromide	III III
		Sample suspected asbestos materials for asbestos presence.		10 (est.)	Laboratory	Asbestos	III
Residual Liquids Concentrations and Volume		Open piping and drum liquids. Sample liquids present in piping and equipment. Estimate volume of liquids present visually.	Piping and Equipment	50 (est.)	Laboratory Field Measurement	TAL Reactivity Ignitability Chlorine Content BTU and Ash Content Compatibility	V III III III III I
Concentration of Roof Runoff		Sample during precipitation event. If no rain occurs during the sampling period, hose down roofs with "clean" water and sample drains.	Drain pipes	7 (est.) 2 (est.)	Laboratory	Arsenic TCL(BNAs) & Aniline	IV V
Laboratory Wastes Concentrations and Volume	"Hazardous Waste" Determination	Perform compatibility testing on laboratory wastes and combine compatible wastes into drums. Sample full drums for parameters necessary to evaluate disposal options.	Laboratory Wastes	100 (est.) 100 (est.) 75 (est.) 100 (est.)	Field Measurement Laboratory	Compatibility Tests Reactivity Ignitability TAL Metals BTU Content Chloride Content Ash Content TCLP Metals GC/IR Scan	I III III V III III III III II

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TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE ELEVEN

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Process Buildings (Continued)							
Groundwater Levels Groundwater Concentrations		Install 2 monitoring wells north of Buildings 1-7 and 1 monitor well east of Building 8. Collect 2 rounds of samples from these wells. Also collect at least two rounds of water-level measurements.	North of Bldgs. 1-7 and east of Bldg. 8	6: 3 wells x 2 rounds 3: 3: 3: 3: 1: Selected Sample 6: 3 wells x 2 rounds	Laboratory Laboratory Laboratory Field Measurement	TCL (VOA) TCL(BNAs) & Aniline TOC, COD, BOD TAL (1st round only) As, Fe (2nd round) Common Anions (1st round) Total Alkalinity (1st round) Pesticides/PCBs Cyanide pH Eh Dissolved Oxygen Conductivity Temperature	IV V III IV IV III III IV IV I I I I I
Soil Concentrations near and under buildings		Construct 3 soil borings adjacent to the buildings to assess soil contamination. Sample the soil borings at 0-3 inches. Also collect one or 2 subsurface samples per boring, depending on depth. Submit 2 samples for pesticides/PCB, cyanide, VOA, TAL, BNA, and aniline analyses.	Building soil borings 2 locations 2 locations 2 locations	2: 2 selected subsurface samples 6: 3 borings x 2 samples/boring 2 samples 2 samples 6: 3 samples/boring	Laboratory Laboratory Laboratory	TCL (VOAs) TAL TCL(BNAs) & Aniline Arsenic, Iron Pesticides/PCBs Cyanide Cation Exchange Capacity	IV IV V IV IV IV III

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TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE TWELVE

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Process Buildings (Continued)							
Soil Leachability	"Hazardous Waste" Determination	Submit 1 subsurface sample per every other boring for TCLP analysis	2 boring locations	2 samples	Laboratory	TCLP	III
Building Surface Concentrations Building Subsurface Concentrations	Treatability of Liquids, Building Materials, and Equipment	If appropriate, evaluate the need for building surface and subsurface sampling and the treatability testing of residual liquids, equipment, and building materials at a later date.					

300224

TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE THIRTEEN

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE Drums and Tanks							
Drum Concentrations	"Hazardous Waste" Determination Drum Contents Bulkability	Collect a sample aliquot from each drum identified with a specific waste stream (65 est.) and each drum of unknown origin (47 est.). Also collect sample aliquots from selected drums (38 est.) to verify homogeneity of drums from the same waste stream. Sample liquids with glass rods and solids with spoons or another appropriate device. Perform compatibility testing on drum aliquots and combine compatible aliquots into samples for laboratory analyses. Analyze samples for parameters necessary to evaluate disposal options.	30 (est.) 30 (est.) 30 (est.) 30 (est.) 150 (est.) 20 (est.) 30 (est.) 30 (est.) 20 (est.)		Laboratory Laboratory Laboratory Laboratory Field Laboratory Laboratory Laboratory Laboratory	PCBs TAL Metals Ignitability Reactivity Compatibility Tests TCLP (Solids) BTU and Ash Content Chlorine Content GC/IR Scan	V V III III I III III III II
Tank Concentrations	"Hazardous Waste" Determination	Sample tank liquids or sludges with glass rods.	Each non-empty wastewater tank	10 (est.)	Laboratory Laboratory Laboratory Field Laboratory Laboratory	TAL Metals Ignitability Reactivity Compatibility Tests BTU and Ash Content Chlorine Content	V III III I III III
	Drum Quantities and Volumes	Drum quantities will be estimated during the field activities.	Each non empty drum				
	Tank Quantities and Volumes	Calculate tank quantities visually and the volumes in each tank using the liquid depth.	Each non-empty tank		Field Measurement	Depth to Liquid or Sludge	I

TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE FOURTEEN

Data Needs: Risk	Data Needs: Engineering	Investigative Technique	Location	Number of Samples	Analyses: Type	Analyses: Parameter	Selected Analytical Option
SOURCE: Waste Pits (Bldgs. 6,9, and 11)							
Contaminant Concentrations in Soil		Dig 1 test pit per each former (Bldgs. 9 and 11) pit and 2 test pits per each existing pit (Bldg. 6). Collect 2 samples, 1 surface and 1 subsurface, from each test pit. Analyze 1 additional subsurface sample from two test pits for TCL and TAL.	One pit per each former site Two test pits at every active pit	8: 2 per site x 4 sites 2: 2 selected samples	Laboratory Laboratory	Arsenic, Iron Aniline TCL (VOA), TAL TCL(BNAs) & Aniline	IV V IV V
Soil Contaminant Leachability	"Hazardous Waste" Determination	Submit one 1 sample per every other test pit for TCLP analysis.		2: 1 per every other site	Laboratory	TCLP (Metals)	III
	Soil Density	Estimate soil density from the literature.					
Building 6 Pit status		Pump out the Building 6 pit and observe for cracks, corroded areas, etc.			Visual		
Groundwater Concentrations	Depth to Groundwater	Three, two and one well will be installed at the Building 6, Building 11, and Building 9 pits, respectively. Two rounds of samples and at least two rounds of water-level measurements will be collected per well.	6 pit locations	12: 6 wells x 2 rounds 6: 6: 6: 1st round only 12: both rounds	Laboratory Laboratory Laboratory Field Measurement	TCL (VOA) TCL(BNAs) & Aniline TOC, COD, BOD TAL (1st round) As, Fe (2nd round) Common Anions Total Alkalinity pH Conductivity Dissolved Oxygen Eh Temperature	IV V III IV IV III III I I I I I

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TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE FIFTEEN

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Waste Pits (Bldgs. 6,9, and 11) (Continued)							
Extent of Contamination Contaminants Concentrations of Wastes, if any	Contaminated Soil Volume and Treatability Contaminated Waste Volume, Density and Treatability	If significant contamination and/or concentrated wastes are found during the above program, the need for groundwater sampling, additional soil (and waste) sampling, and treatability testing will be assessed.					
SOURCE: 1951 Pit							
Contaminant Levels in Soil		Dig 3 test pits and collect 2 samples (1 surface and 1 subsurface sample) per pit. Analyze 2 additional selected subsurface samples for TCL and TAL. If buried drums or waste is observed, sample the drums or waste as one of the selected samples.	3 pits at site	6: 2 per site x 3 sites 2: 2 selected samples	Laboratory Laboratory	Arsenic, Iron Aniline TAL, TCL (VOA) TCL(BNAs) & Aniline	IV V IV V
Soil Contaminant Leachability	"Hazardous Waste" Determination	Submit 2 selected subsurface samples for TCLP analysis.		2: 2 selected samples	Laboratory	TCLP (Metals)	III
	Soil Density	Estimate soil density from the literature.					

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TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE SIXTEEN

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: 1951 Pit (Continued)							
Depth to Groundwater Groundwater Concentrations		One monitoring well will be emplaced adjacent to the 1951 pit. Two rounds of chemical samples and at least two rounds of water level measurements will be taken.	1 site at pit	2: 1 well x 2 rounds 1: 1: 1: 1st round only 2: 1 well x 2 rounds	Laboratory Laboratory Laboratory Field Measurement	TCL (VOA) TCL(BNAs) & Aniline COD, BOD, TOC TAL (1st round) As, Fe (2nd round) Common Anions Total Alkalinity pH Eh Temperature Dissolved Oxygen Conductivity	IV V III IV IV III III I I I I I
Extent of Contamination Contaminant Concentrations of Wastes, if any	Contaminated Soil Volume and Treatability Contaminated Waste Volume, Density and Treatability	If significant contamination and or concentrated wastes are found during the above program, the need for groundwater sampling, additional soil (and waste) sampling, and treatability testing will be assessed.					

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TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
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Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Photographic Anomalies							
Contaminant Concentrations in Soils		Construct two test pits in each of the nine aerial anomaly areas to detect the presence of contaminants in underlying soils. Two or three samples will be collected, including one at 0-3 inches. All samples will be analyzed for arsenic, iron, and aniline. Additionally one subsurface sample per every other pit will be analyzed for TAL and TCL (BNA and VOAs).	2 pits per site	36: 18 pits x 2 samples/pit 9: 1 per every other pit	Laboratory Laboratory	Arsenic, Iron Aniline TCL (VOA), TAL TCL(BNAs) & Aniline	IV V IV V
Soil Contaminant Leachability	"Hazardous Waste" Determination	Submit 1 subsurface sample per every other pit for TCLP analysis.		9: 1 per every other pit	Laboratory	TCLP (Metals)	III
	Soil Density	Estimate soil density from the literature.					
Extent of Contamination	Contaminated Soil Volume and Treatability Surface Soil Volume and Treatability	If significant contamination is found during the above program, the need for additional soil and surficial sampling, groundwater sampling, and treatability testing will be assessed.					

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TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE EIGHTEEN

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Photographic Anomalies (Continued)							
Depth to Groundwater Groundwater Concentrations		Five monitoring wells will be placed adjacent to the anomalies areas. Two rounds of chemical samples and at least two rounds of water-level measurements will be taken from each well.		10: 5 wells x 2 rounds 5: 1st round only 5: 2nd round only 5: 1st round only 10: 5 wells x 2 rounds	Laboratory Laboratory Laboratory Laboratory Field Measurement	TCL (VOA) TCL(BNAs) & Aniline TOC, COD, BOD TAL As, Fe Common Anions Total Alkalinity pH Eh Temperature Conductivity Dissolved Oxygen	IV V III IV IV III III I I I I I
SOURCE: DDAA Storage Areas							
Contaminant Concentrations in Soils		Construct 2 test pits in each former DDAA storage area to detect the presence of contaminants in underlying soils. Two or three samples per pit will be collected, including 1 at 0-3 inches, and 1 or 2 subsurface samples. All samples will be analyzed for arsenic and aniline. Additionally one subsurface sample from each site will be analyzed for TAL and TCL (BNAs and VOAs).	2 pits per site	8: 4 pits x 2 samples/pit 2: 1 per site 2: 1 per site	Laboratory Laboratory Laboratory	Arsenic, Iron Aniline TCL (VOAs), TAL TCL(BNAs) & Aniline	IV V IV V

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TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE NINETEEN

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: DDAA Storage Areas							
Contaminant Leachability	"Hazardous Waste" Determination	Submit one subsurface sample per site for TCLP analysis.		2: 1 per site	Laboratory	TCLP (Metals)	III
	Soil Density	Estimate soil density from the literature.					
Extent of Contamination	Contaminated Soil volume and treatability	If significant contamination is found during the above program, the need for additional soil and surficial sampling, groundwater sampling, and treatability testing will be assessed.					
SOURCE: Drum Storage Areas							
Contaminant concentrations in soils		Construct 2 soil borings in each of the five former and present drum storage areas to detect the presence of contaminants in underlying soils. Two or 3 samples will be collected, depending on soil depth. All samples will be analyzed for arsenic and aniline. Additionally 1 subsurface sample per site will be analyzed for TAL and TCL.	2 soil borings per site	20: 10 borings x 2 samples/ boring 5: 1 per site	Laboratory Laboratory	Arsenic, Iron Aniline TCL (VOAs), TAL TCL(BNAs) & Aniline	IV V IV V

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TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE TWENTY

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Drum Storage Areas (Continued)							
Soil Contaminant Leachability	"Hazardous Waste" Determination	Submit 1 subsurface sample per site for TCLP analysis.		S: 1 per site	Chemical	TCLP (Metals)	III
	Soil Density	Estimate soil density from the literature.					
Depth to groundwater Extent of Contamination Groundwater concentrations	Contaminated soil volume and treatability	If significant contamination is found during the above program, the need for additional soil and surficial sampling, groundwater sampling, and treatability testing will be assessed.					

TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE TWENTY-ONE

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Onsite Soils							
Soil Surface Concentrations Subsurface Soil Concentrations Extent of Contamination	Soil Volume	In addition to the 41 source-related soil borings on site, an additional 18 soil borings will be placed on site away from the sources to assess subsurface contamination. At the boring sites, surface soil samples will be collected (0-3 inches), as part of the onsite surface soil program. One or 2 subsurface samples will be collected from each boring, depending on soil depth. One subsurface sample per every other boring will be submitted for a full TCL-TAL scan.	18 non-source borings	36: 18 borings x 2 samples/ boring 9: 1 per every other boring	Laboratory	Arsenic, Iron TCL (VOA), TAL TCL(BNAs) & Aniline	IV IV V
Contaminant Leachability	"Hazardous Waste" Determination	One subsurface sample per every other boring will be subjected to TCLP to assess leachability of contaminants.		9 samples	Laboratory	TCLP	III
Runoff Concentrations		Surface soil runoff concentrations will be assessed as part of the surface water program.					

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TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE TWENTY-TWO

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Onsite Soils (Continued)							
Background Concentrations		Background soil concentrations will be obtained during the offsite soil program					
	Soil Density	Estimate soil density from the literature.					
Prevailing Winds		Literature Survey					
Air Concentrations	Surface and subsurface soil treatability Groundwater Levels Groundwater Concentrations	If significant surface soil contamination is found on site, the need for air monitoring and treatability will be assessed.					
SOURCE: Offsite Soils							
Soil Surface Concentrations Extent of Contamination Subsurface Soil Concentrations Background Concentrations	Surface Soil Volume Subsurface Soil Volume	Collect samples of soils from 22 soil boring locations at the following intervals: 0-3 inches and soil mantle rock interface. Collect 1 additional sample from subsurface if soil has sufficient depth. Analyze 1 subsurface sample per every other boring for a full TCL-TAL scan.	22 soil boring locations	44: 22 borings x 2 samples/ boring 11: 1 per every other boring	Laboratory Laboratory	Arsenic, Iron TCL(BNAs) & Aniline TAL, TCL (VOA)	IV V IV
		Collect 6 additional surface soil samples to assess wind transport of stack emissions	6	6 samples	Laboratory	Arsenic, Iron	IV

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TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE TWENTY-THREE

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Offsite Soils (Continued)							
Contaminant Leachability	"Hazardous Waste" Determination	To estimate contaminant leachability and determine if some soils are hazardous waste, on subsurface of the soil samples collected per boring will be analyzed for TCLP. Sampling will be biased to select visually contaminated samples.	11 selected samples	11 samples	Laboratory	TCLP (Metals)	III
	Soil Attenuation Capacity	Stir reactor testing at different liquid-soil ratios. Well water from background wells and contaminated soil will be used.	5 selected boring locations	80: 4 analyses per test x 4 tests per soil sample x 5 soil samples 5: Soil samples	Special Laboratory	As, Aniline, PCE Iron, TOC, CEC, Grain Size	V III
	Soil Density	Soil density will be estimated from the literature.					
Runoff Concentrations		Runoff samples will be collected as part of the surface water program.					
Prevailing Winds		Literature Survey.					
Air Concentrations	Treatability (if contaminated)	If contamination found, evaluate need for further sampling and/or treatability tests.					

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TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE TWENTY-FOUR

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Surface Water and Sediments							
Surface Water Concentrations (Background and Downstream) Sediment Concentrations (Background and downstream)	Contaminated Sediment Volume	Collect upstream and downstream filtered and unfiltered surface water and sediment samples from 14 locations. Surface water samples will be collected 2 times; during high flow and low base flow. Three samples from the first round will be analyzed for full TAL/TCL.	See Table 3-8 See Figures 3-5 and 3-6	28 unfiltered surface water (14 locations x 2 rounds)	Field Measurement	Temperature Eh pH Conductivity Dissolved Oxygen	I I I I I
					Laboratory	Total Suspended Solids Nitrate/Nitrite Hardness Alkalinity	III III III III
				28 Filtered surface water (14 locations x 2 rounds)	Laboratory	Arsenic, Iron	IV
Extent of Contamination		Sediment samples will be collected during the first round only.		25 Unfiltered surface water samples (14 1st round and 11 2nd round)	Laboratory	Arsenic, Iron Aniline	IV V
				14 sediment samples (14 locations-second round)	Laboratory	Total Organic Carbon Grain Size Distribution pH Eh	III III III III
				11 sediment samples	Laboratory	Arsenic, Iron Aniline PCE	IV V IV

TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE TWENTY-FIVE

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Surface Water and Sediments (Continued)							
		Full TCL and TAL unfiltered surface water and sediment samples will be collected from 1 upstream location (Prescott Drive Bridge) and 2 downstream locations (Fairlane Avenue Bridge and College Street Bridge) during the second round only.		3 unfiltered surface water (1st round only)	Laboratory	TAL, TCL (VOA)	IV
						TCL(BNAs) & Aniline	V
				3 sediment samples	Laboratory	TAL,TCL (VOA)	IV
						TCL(BNAs) & Aniline	V
		Collect composite downgradient surface water and sediment samples from 6 lakes: Myerstown Pond Wenger Quarries (2) Western Quarry Charming Forge Lake Lakeside Quarry One sampling round will be collected.	Myerstown Pond Wenger Quarries (2) Western Quarry Charming Forge Lake Lakeside Quarry	6 Unfiltered surface water samples (1 round)	Field Test	Temperature	I
						Eh	I
						pH	I
						Dissolved Oxygen	I
						Conductivity	I
					Laboratory	Arsenic, Iron	IV
						Aniline	V
						Total Suspended Solids	III
						Alkalinity	III
						Hardness	III
				6 sediment samples (1 round)	Laboratory	Total Organic Carbon	III
						Grain Size Distribution	III
						pH	III
						Eh	III
						Arsenic, Iron	IV

TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE TWENTY-SIX

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Surface Water and Sediments (Continued)							
Surface Runoff Concentrations	Surface Runoff Volume	Collect 3 upstream samples from the Ramona Road Bridge and 27 samples from the downstream Fairlane Avenue Bridge during a 1" or greater rain event and for the next 24 hours to evaluate surface runoff and calibrate surface runoff models. Measure flow and rainfall during event and flow for 24 hours afterward. Use models to predict effects of other rain events.	Ramona Road and Fairlane Ave. Stations	30 samples	Laboratory	Arsenic	IV
Biota Inventory Biota Concentration		Conduct a benthic invertebrate inventory during early fall at 5 locations along Tulpehocken Creek, including two background locations. Conduct a fishery assessment, including fish tissue assay, during early fall, at 8 locations, including 1 upstream location, 4 downstream locations and 3 downstream lakes.	5 locations (see Table 3-8) 8 locations (see Table 3-8)	 8 samples 8 samples	 Whole Tissue Edible Tissue	 Arsenic Arsenic	 V V

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TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE TWENTY-SEVEN

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Surface Water and Sediments (Continued)							
Biota Inventory Biota Concentration (continued)		Conduct a wetlands delineation from the site downstream to a maximum distance Charming Forge Lake in late summer.	Site to Charming Forge Lake				
User Inventory		Investigate surface water rights and withdrawals.					
	Sediment Density	Sediment density will be estimated from the literature.					
	Stream Flow	Conduct a literature search and establish stream flow measurement points as needed. An estimated five points will need to be installed	5 locations				
	Groundwater Discharge Volume	A groundwater conceptual model will be utilized to estimate groundwater discharge to surface water. An estimated 5 staff gauges will be installed and a pump test conducted to provide model input.					
	Sediment Treatability	If necessary, surface water and sediment treatability tests will be conducted during Phase II.					

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TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE TWENTY-EIGHT

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Groundwater Contaminant Concentrations							
Groundwater Contaminant Concentrations	Plume Dimensions and Volume	A fracture trace analysis will be performed to assist in locating wells.					
Background Concentrations		Install 4 additional onsite wells and 22 new offsite wells to evaluate groundwater contamination. Rehabilitation of old WLI wells will be considered. These wells are in addition to the vault, lagoon, and process building wells.	Well network (see Figure 3-1)	68: 26 new wells x 2 rounds plus 8 residential wells x 2 rounds)	Laboratory	TCL (624-625 onsite and offsite wells, 601-602 residential wells)	IV
Source Contributions						TOC, COD, BOD	III
				34: 34 wells	Laboratory	TAL (1st round)	IV
						Arsenic (2nd round)	IV
		Collect 2 rounds of samples from emplaced wells and 8 selected residential wells. All metals samples to be both filtered and unfiltered. Those old WLI wells not rehabilitated will be grouted to prevent contaminant movement through the boreholes.				Common Anions (1st round)	III
						Alkalinity (1st round)	III
				68:	Field Measurement	pH	I
						Dissolved Oxygen	I
						Eh	I
						Conductivity	I
						Temperature	I

TABLE 3-5
INVESTIGATION MATRIX
WHITMOYER LABORATORIES SITE
PAGE TWENTY-NINE

Data Needs		Investigative Technique	Location	Number of Samples	Analyses		Selected Analytical Option
Risk	Engineering				Type	Parameter	
SOURCE: Groundwater Contaminant Concentrations							
	Groundwater flow direction and rate	Take at least 2 rounds of water levels in new and existing wells Conduct a pump test on a new onsite well, incorporating existing wells in the water-level measurement network.	All wells New Onsite Well	Approximately 60 per round	Field Measurement	Water Level	I
User Inventory		The existing well user inventory will be supplemental by an information collection system, as needed.					
	Aquifer washing data In-situ precipitation data Groundwater treatability data Biodegradation data	Once the first round of groundwater sample data has been received, the need for treatability studies will be assessed.					

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TABLE 3-6

SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE

Matrix - Onsite Groundwater (Round 1)

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
30	2	2	2	4	40	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	2, 40-ml glass vials	80	7 days	Cool to 4°C
30	2	2	2	--	36	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	1, 80-oz amber glass	36	7 days to extraction, 40 days after	Cool to 4°C
30	2	2	2	--	36	1,2,3,4,5	IV	TAL Metals (filtered)	CLP-RAS	CLP Protocol	1, 1-liter plastic bottle	36	6 months; Hg-28 days	HNO_3 to pH<2; Cool to 4°C
30	2	2	2	--	36	1,2,3,4,5	IV	Total Arsenic (unfiltered)	CLP-RAS	CLP Protocol	1, 1-liter plastic bottle	36	6 months	HNO_3 to pH<2; Cool to 4°C
4	1	1	1	--	7	1,2,3,4,5	III	Total Arsenic (filtered)	CLP-SAS	SM 303E prep. 5.d	1, 1-liter plastic bottle	7	6 months	HNO_3 to pH<2; Cool to 4°C
4	1	1	1	--	7	1,2,3,4,5	IV	Cyanide	CLP-RAS	CLP Protocol	1, 1-liter plastic bottle	7	14 days	NaOH to pH>12; Cool to 4°C
4	1	1	1	--	7	1,2,3,4,5	IV	TCL Pesticides/ PCBs	CLP-RAS	CLP Protocol	1, 80-oz amber glass	7	7 days to extraction, 40 days after	Cool to 4°C
30	2	--	--	--	32	1,4,5	III	Common Anions(d)	REM III-SAS	EPA 300.0	1, 1-liter plastic bottle	32	28 days	Cool to 4°C
30	2	--	--	--	32	1,4,5	III	Alkalinity	REM III-RAS	EPA 130.1	1, 1-liter plastic bottle	32	14 days	Cool to 4°C
30	2	--	--	--	32	1,3,4,5	III	COD	REM III-SAS	EPA 410.1	1, 500-ml plastic bottle	32	28 days	H_2SO_4 to pH<2; Cool to 4°C
30	2	-	--	--	32	1,3,4,5	III	BOD_5	REM III-SAS	SM 507	1, 1 liter plastic bottle	32	48 hours	Cool to 4°C

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
PAGE TWO

Matrix - Onsite Groundwater (Round 1) - Continued

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
30	2	--	--	--	32	1,3,4,5	III	TOC	REM III-SAS	EPA 415.1	(v)	32(v)	28 days	H_2SO_4 to pH<2; Cool to 4°C
30	2	--	--	--	32	1,4,5	I	Eh, pH, Temperature, Specific Conductance, Dissolved Oxygen	Field Analysis	Primary Specific Ion Electrode	NA	--	NA	NA

Matrix - Onsite Groundwater (Round 2)

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
60	3	3	3	--	69	1,2,3,4,5	IV	Total Arsenic (filtered & unfiltered)	CLP-SAS	CLP Protocol	1, 1-liter plastic bottle	69	6 months	HNO_3 to pH<2; Cool to 4°C
30	2	2	2	--	36	1,2,3,4,5	V	TCL B/N/A-E and aniline	CLP-SAS	CLP Protocol	1, 80-oz. amber glass	36	7 days to extraction; 40 days after	Cool to 4°C
30	2	2	2	4	40	1,2,3,4,5	IV	TCL Volatiles	CLP RAS	CLP Protocol	2, 40-ml glass vials	80	7 days	Cool to 4°C
30	2	--	--	--	32	1,3,4,5	III	COD	REM III-SAS	EPA 410.1	1, 500-ml plastic bottle	32	28 days	H_2SO_4 to pH<2; Cool to 4°C
30	2	--	--	--	32	1,3,4,5	III	BOD_5	REM III-SAS	SM 507	1, 1-liter plastic bottle	32	48 hours	Cool to 4°C
30	2	--	--	--	32	1,3,4,5	III	TOC	REM III-SAS	EPA 415.1	(v)	32(v)	28 days	H_2SO_4 to pH<2; Cool to 4°C
30	2	--	--	--	32	1,4,5	I	Eh, pH, Temperature, Specific Conductance, Dissolved Oxygen	Field Analysis	Primary Specific Ion Electrode	NA	--	NA	NA

TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
PAGE THREE

Matrix - Offsite Groundwater (Round 1)

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
22	2	2	2	3	31	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	2, 40-ml glass vials	62	7 days	Cool to 4°C
8	1	1	1	1	12	1,2,3,4,5	V	TCL Volatiles(c)	CLP-SAS	EPA 601/602	2, 40-ml glass vials	24	7 days	Cool to 4°C
30	2	2	2	--	36	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	1, 80-oz amber glass	36	7 days to extraction; 40 days after	Cool to 4°C
30	2	2	2	--	36	1,2,3,4,5	IV	TAL Metals (filtered)	CLP-RAS	CLP Protocol	1, 1-liter plastic bottle	36	6 months; Hg-28 days	HNO_3 to pH<2; Cool to 4°C
34(t)	2	2	2	--	40	1,2,3,4,5	IV	Total Arsenic (unfiltered)	CLP-RAS	CLP Protocol	1, 1-liter plastic bottle	40	6 months	HNO_3 to pH<2; Cool to 4°C
30	2	--	--	--	32	1,4,5	III	Common Anions(d)	REM III-SAS	EPA 300.0	1, 1-liter plastic bottle	32	28 days	Cool to 4°C
30	2	--	--	--	32	1,4,5	III	Alkalinity	REM III-RAS	EPA 130.1	1, 1-liter plastic bottle	32	14 days	Cool to 4°C
30	2	--	--	--	32	1,3,4,5	III	COD	REM III-SAS	EPA 410.1	1, 500-ml plastic bottle	32	28 days	H_2SO_4 to pH<2; Cool to 4°C
30	2	--	--	--	32	1,3,4,5	III	BOD_5	REM III-SAS	SM 507	1, 1-liter plastic bottle	32	48 hours	Cool to 4°C
30	2	--	--	--	32	1,3,4,5	III	TOC	REM III-SAS	EPA 415.1	(v)	32(v)	28 days	H_2SO_4 to pH<2; Cool to 4°C
30	2	--	--	--	32	1,4,5	I	Dissolved Oxygen, Eh, pH, Specific Conductance	Field Analysis	Primary Specific Ion Electrode	NA	--	NA	NA

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
PAGE FOUR

Matrix - Offsite Groundwater (Round 2)

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
30	2	2	2	--	36	1,2,3,4,5	IV	Total Arsenic (filtered)	CLP-SAS	CLP Protocol	1, 1-liter plastic bottle	36	6 months	HNO_3 to pH<2, Cool to 4°C
22	2	2	2	3	31	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	2, 40 ml glass vials	62	7 days	Cool to 4°C
8	1	1	1	1	12	1,2,3,4,5	V	TCL Volatiles(c)	CLP-SAS	EPA 601/602	2, 40 ml glas vials	24	7 days	Cool to 4°C
30	2	2	2	--	36	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	1, 80-oz amber glass	18	7 days to extraction; 40 days after	Cool to 4°C
30	2	--	--	--	32	1,3,4,5	III	COD	REM III-SAS	EPA 410.1	1, 500 ml plastic bottle	32	28 days	H_2SO_4 to pH<2; Cool to 4°C
30	2	--	--	--	32	1,3,4,5	III	BOD_5	REM III-SAS	SM 507	1, 1 liter plastic bottle	32	48 hours	Cool to 4°C
30	2	--	--	--	32	1,3,4,5	III	TOC	REM III-SAS	EPA 415.1	(v)	32(v)	28 days	H_2SO_4 to pH<2; Cool to 4°C
30	2	--	--	--	32	1,4,5	I	Dissolved Oxygen, Eh,pH, Specific Conductance	Field Analysis	Primary Specific Ion Electrode	NA	--	NA	NA

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
PAGE FIVE

Matrix - Vault Waste

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
4	1	1	--	1	7	1,3,4	V	TCL Volatiles	CLP-SAS	CLP (h) Protocol	(e)	14	7 days	Cool to 4°C
4	1	1	--	--	6	1,3,4	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP (h) Protocol	(e)	6	7 days to extraction; 40 days after	Cool to 4°C
4	1	1	--	-	6	1,3,4	V	TAL Metals	CLP-SAS	CLP (h) Protocol	(e)	6	6 months; Hg-28 days	Cool to 4°C
2	1	1	--	--	4	1,3,4	V	TCL Pesticides/ PCBs	CLP-SAS	CLP (h) Protocol	(e)	4	7 days to extraction; 40 days after	Cool to 4°C
2	1	1	--	--	4	1,3,4	V	Cyanide	CLP-SAS	CLP (h) Protocol	(e)	4	14 days	Cool to 4°C
4	--	--	--	--	4	1,3,4	III	TCLP (Metals)	CLP-SAS	(i)	1, 32-oz. wide-mouth bottle	4	NA	NA

Matrix - Vault Tracer

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
29	2	2	--	--	33	1,2,3,4,5	III	Lithium	REM III-SAS	CLP Protocol	1, 500-ml glass jar	33	6 months	HNO_3 to pH<2 Cool to 4°C

TABLE 3-6
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WHITMOYER LABORATORIES SITE
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Matrix - Vault Perimeter Soils

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
2	1	1	--	1	5	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	2, 120-ml wide-mouth glass jars	10	7 days	Cool to 4°C
2	1	1	--	--	4	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	4	7 days to extraction; 40 days after	Cool to 4°C
2	1	1	--	--	4	1,2,3,4,5	IV	TAL Metals	CLP-RAS	CLP Protocol	1, 8-oz wide-mouth glass jar	4	6 months; Hg-28 days	Cool to 4°C
6	1	1	--	--	8	1,2,3,4,5	IV	Total Arsenic/ Iron	CLP-SAS	CLP Protocol	1, 8 oz wide-mouth glass jar	8	6 months	Cool to 4°C
2	--	--	--	--	2	1,2,3,4,5	III	TCLP (Metals)	CLP-RAS	CLP Protocol	1, 32-oz. wide-mouth bottle	2	NA	NA

TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
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Matrix - Sludge From Consolidated Lagoons

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements		Holding Time	Preservation Requirements
											Per Sample	Total		
8	1	1	--	2	12	1,3,4	V	TCL Volatiles	CLP-SAS	CLP (h) Protocol	(e)	12	7 days	Cool to 4°C
8	1	1	--	--	10	1,3,4	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP (h) Protocol	(e)	10	7 days to extraction; 40 days after	Cool to 4°C
6	1	1	--	--	8	1,3,4	V	TCL Pesticides/ PCBs	CLP-SAS	CLP (h) Protocol	(e)	8	7 days to extraction; 40 days after	Cool to 4°C
8	1	1	--	--	10	1,3,4	V	TAL Metals	CLP-SAS	CLP (h) Protocol	(e)	10	6 months	Cool to 4°C
6	1	1	--	--	8	1,3,4	V	Cyanide	CLP-SAS	CLP (h) Protocol	(e)	8	14 days	Cool to 4°C
16	1	1	--	--	18	1,3,4	V	Iron, Arsenic	CLP-SAS	CLP Protocol	(e)	18	6 months	Cool to 4°C
16	1	1	--	--	18	1,3,4	V	Aniline	CLP-SAS	CLP Protocol	(e)	18	7 days to extraction; 40 days after	Cool to 4°C
8	--	--	--	--	8	1,3,4	III	TCLP (Metals only)	CLP-SAS	(i)	1, 32-oz(g) wide-mouth glass jars	8	NA	NA
6	1	--	--	--	7	1,3,4	III	pH, Eh	REM III-SAS	EPA Protocol	1, 8 oz(g) glass jar	7	NA	NA

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
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Matrix - Lagoon Sludge or Sludge/Soil Mixtures

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements		Holding Time	Preservation Requirements
											Per Sample	Total		
4(k)	--	--	--	--	4(k)	4,1	III	Unit Weight	REM III-SAS	ASTM D 2216-80	1 thin-wall tube	4	NA	NA
4(k)	--	--	--	--	4(k)	4,1	III	Natural Water Content	REM III-SAS	ASTM D 2216-80	(j)	4(j)	NA	NA
4(k)	--	--	--	--	4(k)	4,1	III	One Dimensional Consolidation	REM III-SAS	ASTM D 2435-80	(j)	4(j)	NA	NA
4(k)	--	--	--	--	4(k)	4,1	III	Unconfined Compressive Strength	REM III-SAS	ASTM D 2166-66	(j)	4(j)	NA	NA
4(k)	--	--	--	--	4(k)	4,1	III	Grain Size	REM III-SAS	ASTM D 422-63	(j)	4(j)	NA	NA
4(k)	--	--	--	--	4(k)	4,1	III	Specific Gravity	REM III-SAS	ASTM D 854-83	(j)	4(j)	NA	NA
4(n)	--	--	--	--	4(n)	4,1	III	Grain Size	REM III-SAS	ASTM D 422-63	1, 32-oz(q) wide-mouth glass jar	4(q)	NA	NA
4(n)	--	--	--	--	4(n)	4,1	III	Specific Gravity	REM III-SAS	ASTM D 854-83	(m)(q)	4(m)	NA	NA
4(n)	--	--	--	--	4(n)	4,1	III	Natural Water Content	REM III SAS	ASTM D 2216-80	(m)(q)	4(m)	NA	NA
4(n)	--	--	--	--	4(n)	4,1	III	Atterberg Limits	REM III-SAS	ASTM D 4318-84	(m)(q)	4(m)	NA	NA

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WHITMOYER LABORATORIES SITE
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Matrix - Lagoon Cap

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
4(k)	--	--	--	--	4(k)	4,1	III	Unit Weight	REM III SAS	ASTM D 2216-80	1 thin-wall tube	4	NA	NA
4(k)	--	--	--	--	4(k)	4,1	III	Natural Water Content	REM III-SAS	ASTM D 2216-80	(j)	4(j)	NA	NA
4(k)	--	--	--	--	4(k)	4,1	III	Grain Size	REM III-SAS	ASTM D 422-63	(j)	4(j)	NA	NA
4(k)	--	--	--	--	4(k)	4,1	III	Specific Gravity	REM III-SAS	ASTM D 854-83	(j)	4(j)	NA	NA
4(k)	--	--	--	--	4(k)	4,1	III	Triaxial Permeability	REM III-SAS	SW846 9100	(j)	4(j)	NA	NA
4(k)	--	--	--	--	4(k)	4,1	III	Atterberg Limits	REM III-SAS	ASTM D 4318-84	(j)	4(j)	NA	NA
4(l)	--	--	--	--	4(l)	4,1	III	Density	Field Analysis	ASTM D 2922-81	NA	NA	NA	NA
4(l)	--	--	--	--	4(l)	4,1	III	Atterberg Limits	REM III-SAS	ASTM D 4318-84	1, 32-oz(q) wide-mouth glass jar	4(q)	NA	NA
4(l)	--	--	--	--	4(l)	4,1	III	Grain Size	REM III-SAS	ASTM D 422-63	(m)(q)	4(m)	NA	NA
4(l)	--	--	-	-	4(l)	4,1	III	Specific Gravity	REM III-SAS	ASTM D 854-83	(m)(q)	4(m)	NA	NA
4(l)	--	--	--	--	4(l)	4,1	III	Triaxial Permeability	REM III-SAS	SW846-9100	1, 32-oz(q) wide-mouth glass jar	4(q)	NA	NA

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
PAGE TEN

Matrix - Lagoon Liner

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
4(k)	--	--	--	--	4(k)	4,1	III	Unit Weight	REM III-SAS	ASTM D 2216-80	1 thin-wall tube	4	NA	NA
4(k)	--	--	--	--	4(k)	4,1	III	Natural Water Content	REM III-SAS	ASTM D 2216 80	(j)	4(j)	NA	NA
4(k)	--	--	--	--	4(k)	4,1	III	Grain Size	REM III SAS	ASTM D 422-63	(j)	4(j)	NA	NA
4(k)	--	--	--	--	4(k)	4,1	III	Specific Gravity	REM III-SAS	ASTM D 854-83	(j)	4(j)	NA	NA
4(k)	--	--	--	--	4(k)	4,1	III	Triaxial Permeability	REM III-SAS	SW846-9100	(j)	4(j)	NA	NA
4(n)	--	--	--	--	4(n)	4,1	III	Grain Size	REM III-SAS	ASTM D 422-63	1, 32-oz(q) wide-mouth glass jar	4(q)	NA	NA
4(n)	--	--	--	--	4(n)	4,1	III	Natural Water Content	REM III-SAS	ASTM D 2216-80	(m)(q)	4(m)	NA	NA
4(n)	--	--	--	--	4(n)	4,1	III	Specific Gravity	REM III-SAS	ASTM D 854-83	(m)(q)	4(m)	NA	NA

Matrix - Groundwater: Lagoon Lysimeters (1st and 2nd Rounds)

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
8	2	2	2	--	14	1,2,3,4,5	IV	Total Arsenic	CLP-SAS	CLP Protocol	1, 1-liter plastic bottle	14	6 months	HNO_3 to pH<2; Cool to 4°C
8	--	--	--	--	8	1,3,4,5	I	pH	Field Analysis	pH paper	NA	NA	NA	NA

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
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PAGE ELEVEN

Matrix - Lagoon Perimeter Soils

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
3	1	1		1	6	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	2, 120-ml wide-mouth glass jars	12	7 days	Cool to 4°C
3	1	1		--	5	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	5	7 days to extraction; 40 days after	Cool to 4°C
3	1	1		--	5	1,2,3,4,5	IV	TAL Metals	CLP RAS	CLP Protocol	1,8-oz wide-mouth glass jar	5	6 months; Hg-28 days	Cool to 4°C
10	1	1		--	12	1,2,3,4,5	IV	Iron, Arsenic	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	12	6 months	Cool to 4°C
3	--	--	--	--	3	1,2,3,4,5	III	TCLP (Metals)	CLP-SAS	(i)	1, 32-oz wide-mouth glass jar	3	NA	NA

Matrix - Excavated Lagoon Soil and Sludge(o)

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
6	1	1		1	9	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	2, 120-ml wide-mouth glass jars	18	7 days	Cool to 4°C
6	1	1		--	8	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	8	7 days to extraction; 40 days after	Cool to 4°C
6	1	1		--	8	1,2,3,4,5	IV	TAL Metals	CLP-RAS	CLP Protocol	1, 8-oz wide-mouth glass jar	8	6 months; Hg-28 days	Cool to 4°C
20	2	2		--	24	1,2,3,4,5	IV	Arsenic, Iron	CLP-SAS	CLP Protocol	1, 8-oz wide mouth glass jar	24	6 months	Cool to 4°C
6	--	--	--	--	6	1,2,3,4,5	III	TCLP (Metals)	CLP-SAS	(i)	1, 32-oz wide-mouth glass jar	6	NA	NA

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
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Matrix - Process Buildings: Building and Equipment Wipe Samples

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements		Holding Time	Preservation Requirements
											Per Sample	Total		
156	8	8	8	--	180	1,2,3,4	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar or vial	180	7 days to extraction; 40 days after	Cool to 4°C
156	8	8	8	--	180	1,2,3,4	IV	Total Arsenic	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar or vial	180	6 months	Cool to 4°C

Matrix - Roof Drainage

2	1	1	1	--	5	1,2,3,4	V	TCL B/N/A-E and Aniline	CLP-RAS	CLP Protocol	1, 80-oz amber glass	5	7 days to extraction; 40 days after	Cool to 4°C
7	1	1	1	--	10	1,2,3,4	IV	Total Arsenic	CLP-SAS	CLP Protocol	1, 1-liter plastic bottle	10	6 months	HNO_3 to pH<2; Cool to 4°C

Matrix - Asbestos

10	1			--	11	1,2,3,4	III	Asbestos	REM III-SAS	EPA-600/MA-82-020 (Dec.1982)	Baggie	11	NA	NA

Matrix - Air (f)

10	1	1	--	--	12	1,2,3,4,5	III	Aniline	REM III SAS	NIOSH Method 5310	NA	NA	7 days	Cool to 4°C
2	1	1	--	--	4	1,2,3,4,5	III	Methyl bromide	REM III-SAS	NIOSH Method 5372	NA	NA	7 days	Cool to 4°C

TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
PAGE THIRTEEN

Matrix - Process Buildings: Soil(p)

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
2	1	1	--	1	5	1,2,3,4	IV	TCL Volatiles	CLP-RAS	CLP Protocol	2, 120-ml wide-mouth glass jars	10	7 days	Cool to 4°C
2	1	1	--		4	1,2,3,4	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	4	7 days to extraction; 40 days after	Cool to 4°C
2	1	1	--	--	4	1,2,3,4	IV	TAL Metals	CLP-RAS	CLP Protocol	1, 8-oz wide-mouth glass jar	4	6 months, Hg-28 days	Cool to 4°C
6	1	1	--	--	8	1,2,3,4	IV	Total Arsenic, Iron	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	14	6 months	Cool to 4°C
6	--	--	--	--	6	1,2,3,4	III	Cation Exchange Capacity	REM III-SAS	SW846-9081	1 16-oz wide-mouth glass jar	6	NA	Cool to 4°C
2	1	1	--	--	4	1,2,3,4,5	IV	Pesticides/PCBs	CLP-RAS	CLP Protocol	1 8-oz wide-mouth glass jar	4	14 days	Cool to 4°C
2	1	1	--	--	4	1,2,3,4,5	IV	Cyanide	CLP-RAS	CLP Protocol	1 8-oz wide-mouth glass jar	4	7 days to extraction; 40 days after	Cool to 4°C
2	--	--	--	--	2	1,2,3,4,5	III	TCLP (Metals)	CLP-SAS	(i)	1, 32-oz wide-mouth glass jar	2	NA	NA

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
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Matrix - Wastes in Piping

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements		Holding Time	Preservation Requirements
											Per Sample	Total		
50	3	3	3	--	59	1,3,4	V	TAL Metals	CLP-SAS	CLP (h) Protocol	(e)	59	6 months Hg-28 days	Cool to 4°C
50	--	--	--	--	50	1,3,4	III	BTU Content	REM III-SAS	ASTM 3286 77	1, 8-oz(q) wide-mouth glass jar	50	NA	Cool to 4°C
50	--	--	--	--	50	1,3,4	III	Ash Content	REM III-SAS	SM 209D	(r)	50(r)	NA	Cool to 4°C
50	--	--	--	--	50	1,3,4	III	Chlorine Content	REM III-SAS	ASTM D808	(r)	50(r)	NA	Cool to 4°C
50	--	--	--	--	50	1,3,4	III	Ignitability	REM III-SAS	SW846-1010	(r)	50(r)	NA	Cool to 4°C
50	--	--	--	--	50	1,3,4	III	Reactivity	REM III-SAS	SW846	(r)	50(r)	NA	Cool to 4°C
50	--	--	--	--	50	1,3,4	I	Compatibility Tests	Field Analysis	Various	NA	NA	NA	NA

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
PAGE FIFTEEN

Matrix - Laboratory Wastes

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
100	5	5	5	--	115	1,3,4	V	TAL Metals	CLP SAS	CLP Protocol (h)	(e)	115	6 months Hg - 28 days	Cool to 4°C
100	--	--	--	--	100	1,3,4	III	BTU Content	REM III-SAS	ASTM 3286 77	1, 8-oz(q) wide-mouth glass jar	100	NA	NA
100	--	--	--	--	100	1,3,4	III	Ash Content	REM III-SAS	SM 209D	(r)	100(r)	NA	NA
100	--	--	--	--	100	1,3,4	III	Chlorine Content	REM III-SAS	ASTM D808	(r)	100(r)	NA	Cool to 4°C
100	--	--	--	--	100	1,3,4	III	Ignitability	REM III SAS	SW 846-1010	(r)	100(r)	NA	NA
100	--	--	--	--	100	1,3,4	III	Reactivity	REM III-SAS	SW 846	(r)	100(r)	NA	NA
100	--	--	--	--	100	1,3,4	I	Compatibility Tests	Field Analysis	Various	NA	NA	NA	NA
100	--	--	--	--	100	1,3,4	II	GC/IR Scan	REM III-SAS	NUS Protocol	(r)	100(r)	NA	Cool to 4°C
75	--	--	--	--	75	1,3,4	III	TCLP (Metals)	CLP-SAS	(i)	1, 32-oz jar	75(q)	NA	NA

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
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Matrix - Wastes in Tanks and Drums

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements		Holding Time	Preservation Requirements
											Per Sample	Total		
40	2	2	2	--	46	1,3,4	V	TAL Metals	CLP-SAS	CLP (h) Protocol	1, 8 oz(q) wide-mouth glass jar	46	6 months	Cool to 4°C
30	2	2	2	--	36	1,3,4	V	PCB's	CLP-SAS	CLP (h) Protocol	1, 8 oz(q) wide-mouth glass jar	36	7 days to extraction; 40 days after	Cool to 4°C
40	--	--	--	--	40	1,3,4	III	BTU Content	REM III-SAS	ASTM 3286-77	1, 8 oz(q) wide-mouth glass jar	40	NA	Cool to 4°C
40	--	--	--	--	40	1,3,4	III	Ash Content	REM III-SAS	SM209D	(r)	40 (r)	NA	Cool to 4°C
40	--	--	--	--	40	1,3,4	III	Chlorine Content	REM III-SAS	ASTM D808	(r)	40 (r)	NA	Cool to 4°C
20	--	--	--	--	20	1,3,4	II	GC/IR Scan(x)	REM III-SAS	NUS Method	(r)	20 (r)	NA	Cool to 4°C
150	--	--	--	--	150	1,3,4	I	Compatibility Tests	Field Analysis	Various	NA	NA	NA	NA
40	--	--	--	--	40	1,3,4	III	Ignitability	REM III-SAS	SW846-1010	(r)	40 (r)	NA	NA
120	--	--	--	--	-120	1,3,4	III	Reactivity	REM III-SAS	SW846	(r)	40 (r)	NA	NA
20	--	--	--	--	20	1,2,3,4,5	III	TCLP (Metals)(y)	CLP SAS	(i)	1, 32 oz(q) wide-mouth glass jar	20	NA	NA

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
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Matrix - Waste Pit Soils and Sludges

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
2	1	1	--	1	5	1,3,4	IV	TCL Volatiles	CLP-RAS	CLP Protocol	2, 120 ml wide mouth glass jars	10	7 days	Cool to 4°C
2	1	1	--	--	4	1,3,4	V	TCL B/N/A E and Aniline	CLP-SAS	CLP Protocol	1, 8-oz wide mouth glass jar	6	7 days to extraction; 40 days after	Cool to 4°C
8	1	1	--	--	10	1,3,4	IV	Total Arsenic, Iron	CLP-SAS	CLP Protocol	1, 8-oz wide mouth glass jar	10	6 months	Cool to 4°C
2	1	1	--	--	4	1,3,4	IV	TAL Metals	CLP-RAS	CLP Protocol	1, 8-oz wide mouth glass jar	6	6 months, Hg-28 days	Cool to 4°C
8	1	1	--	--	10	1,3,4	V	Aniline	CLP-SAS	CLP Protocol	1, 8 oz wide-mouth glass jar	10	7 days to extraction; 40 days after	Cool to 4°C
2	--	--	--	--	2	1,3,4	III	TCLP (Metals only)	CLP-SAS	(i)	1, 32-oz wide-mouth glass jars	2	NA	NA

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
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Matrix - Offsite Soils (Attenuation Capacity)

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements		Holding Time	Preservation Requirements
											Per Sample	Total		
40	2	2	2	--	46(s)	4,3	IV	Total Arsenic	CLP-SAS	CLP Protocol	1, 80-oz amber glass jar	26	6 months	Cool to 4°C
40	2	2	2	--	46(s)	4,3	V	Aniline	CLP-SAS	CLP Protocol	(z)	26(z)	7 days to extraction; 40 days after	Cool to 4°C
40	2	2	2	2	48(s)	4,3	IV	Tetrachloro-ethene	CLP-SAS	CLP Protocol	(z)	26(z)	7 days	Cool to 4°C
40	2	2	2	--	46	4,3	IV	Total Arsenic	CLP-SAS	CLP Protocol	1, 32 oz wide-mouth glass jar	26	6 months	Cool to 4°C
40	2	2	2	--	46	4,3	V	Aniline	CLP SAS	CLP Protocol	(z)	26(z)	7 days to extraction; 40 days after	Cool to 4°C
40	2	2	2	2	48	4,3	IV	Tetrachloro-ethene	CLP-SAS	CLP Protocol	(z)	26(z)	7 days	Cool to 4°C
5	1	--	--	--	6	4,3	III	Iron	REM III-SAS	CLP Protocol	1, 8 oz wide-mouth glass jar	6	6 months	Cool to 4°C
5	1	--	--	--	6	4,3	III	TOC	REM III-SAS	CASWS P3-65	1, 8 oz wide-mouth glass jar	6	28 days	Cool to 4°C
5	1	--	--	--	6	4,3	III	CEC	REM III-SAS	SW846-9081	1, 16-oz wide-mouth glass jar	6	NA	Cool to 4°C
5	1	--	--	--	6	4,3	III	Grain Size	REM III-SAS	ASTM D422-63	1, 8 oz wide-mouth glass jar	6	NA	NA

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
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Matrix - Photographic Anomalies: Soils

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements		Holding Time	Preservation Requirements
											Per Sample	Total		
9	1	1	--	3	14	1,3,4	IV	TCL Volatiles	CLP-RAS	CLP Protocol	2, 120-ml wide-mouth glass jars	28	7 days	Cool to 4°C
9	1	1	--	--	11	1,3,4	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	11	7 days to extraction; 40 days after	Cool to 4°C
9	1	1	--	--	11	1,3,4	IV	TAL Metals	CLP-RAS	CLP Protocol	1, 8-oz wide-mouth glass jar	11	6 months; Hg-28 days	Cool to 4°C
36	2	2	--	--	40	1,3,4	V	Aniline	CLP SAS	CLP Protocol	1, 8-oz wide mouth glass jar	40	7 days to extraction; 40 days after	Cool to 4°C
36	2	2	--	--	40	1,3,4	IV	Total Arsenic	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	40	6 months	Cool to 4°C
9	--	--	--	--	9	1,3,4	III	TCLP (Metals only)	CLP-SAS	(i)	1, 32-oz wide-mouth glass jar	9	NA	NA

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
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Matrix - Onsite Soils

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements		Holding Time	Preservation Requirements
											Per Sample	Total		
9	1	1	--	2	13	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	2, 120-ml wide-mouth glass jars	26	7 days	Cool to 4°C
9	1	1	--	--	11	1,2,3,4,5	V	TCL B/N/A-E and Anilines	CLP-SAS	CLP Protocol	1,8-oz wide-mouth glass jar	11	7 days to extraction; 40 days after	Cool to 4°C
9	1	1	--	--	11	1,2,3,4,5	IV	TAL Metals	CLP-RAS	CLP Protocol	1,8-oz wide-mouth glass jar	11	6 months; Hg-28 days	Cool to 4°C
36	2	2	--	--	40	1,2,3,4,5	IV	Total Arsenic, Iron	CLP SAS	CLP Protocol	1,8-oz wide-mouth glass jar	40	6 months	Cool to 4°C
9	--	--	--	--	9	1,2,3,4,5	III	TCLP (Metals only)	CLP-SAS	CLP Protocol	1, 32-oz wide-mouth glass jar	9	NA	NA

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
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Matrix - Offsite Soils

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements		Holding Time	Preservation Requirements
											Per Sample	Total		
11	1	1	--	2	15	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	2, 120 ml wide-mouth glass jars	30	7 days	Cool to 4°C
11	1	1	--	--	13	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	1, 8 oz wide mouth glass jar	13	7 days to extraction; 40 days after	Cool to 4°C
11	1	1	--	--	13	1,2,3,4,5	IV	TAL Metals	CLP-RAS	CLP Protocol	1, 8-oz wide-mouth glass jar	13	6 months; Hg-28 days	Cool to 4°C
62(t)	4	4	--	--	70	1,2,3,4,5	IV	Iron, Arsenic	CLP-SAS	CLP Protocol	1, 8-oz wide mouth glass jar	70	6 months	Cool to 4°C
11	--	--	--	--	11	1,2,3,4,5	III	TCLP (Metals)	CLP-SAS	(1)	1, 32-oz wide-mouth glass jar	11	NA	NA

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
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Matrix - 1951 Pit Soils

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
2	1	1	--	1	5	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	2, 120-ml wide-mouth glass jars	10	7 days	Cool to 4°C
2	1	1	--	--	4	1,2,3,4,5	V	TCL B/N/A-" and Aniline	CLP SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	4	7 days to extraction; 40 days after	Cool to 4°C
2	1	1	--	--	4	1,2,3,4,5	IV	TAL Metals	CLP-RAS	CLP Protocol	1, 8-oz wide-mouth glass jar	4	6 months; Hg-28 days	Cool to 4°C
6	1	1	--	--	8	1,2,3,4,5	IV	Iron, Arsenic	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	8	6 months	Cool to 4°C
6	1	1	--	--	8	1,2,3,4,5	V	Aniline	CLP SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	8	7 days to extraction; 40 days after	Cool to 4°C
2	--	--	--	--	2	1,2,3,4,5	III	TCLP (Metals only)	CLP-SAS	(i)	1, 32-oz wide-mouth glass jar	2	NA	NA

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
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Matrix - DDAA Storage Areas

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
2	1	1	--	1	5	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	2, 120-ml wide-mouth glass jars	10	7 days	Cool to 4°C
2	1	1	--	--	4	1,2,3,4,5	V	TCL B/N/A-E andAniline	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	4	7 days to extraction; 40 days after	Cool to 4°C
2	1	1	--	--	4	1,2,3,4,5	IV	TAL Metals	CLP-RAS	CLP Protocol	1, 8-oz wide-mouth glass jar	4	6 months; Hg-28 days	Cool to 4°C
8	1	1	--	--	10	1,2,3,4,5	IV	Iron, Arsenic	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	10	6 months	Cool to 4°C
8	1	1	--	--	10	1,2,3,4,5	V	Aniline	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	10	7 days to extraction; 40 days after	Cool to 4°C
2	--	--	--	--	2	1,2,3,4,5	III	TCLP (Metals only)	CLP-SAS	(i)	1, 32-oz wide-mouth glass jar	2	NA	NA

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TABLE 2-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
PAGE TWENTY-FOUR

Matrix - Drum Storage Areas Soils

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
5	1	1	--	2	9	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	2, 120-ml wide-mouth glass jars or 2, 40-ml glass vials	18	7 days	Cool to 4°C
5	1	1	--	--	7	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	7	7 days to extraction; 40 days after	Cool to 4°C
20	1	1	--	--	22	1,2,3,4,5	V	Aniline	CLP-SAS	CLP Protocol	1, 8 oz wide-mouth glass jar	22	7 days to extraction; 40 days after	Cool to 4°C
20	1	1	--	--	22	1,2,3,4,5	IV	Total Arsenic, Iron	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	22	6 months	Cool to 4°C
5	--	--	--	--	5	1,2,3,4,5	III	TCLP (Metals)	CLP-SAS	(i)	1, 32-oz wide-mouth glass jar	5	NA	NA
5	1	1	--	--	7	1,2,3,4,5	IV	TAL Metals	CLP-RAS	CLP Protocol	1, 8-oz wide-mouth glass jar	7	6 months; Hg-28 days	Cool to 4°C

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
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Matrix - Surface Water

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements Per Sample	Bottle Requirements Total	Holding Time	Preservation Requirements
3	1	1	1	1	7	1,2,3,4,5	V	TCL Volatiles	CLP-SAS	EPA 601/602	2, 40 ml glass vials	14	7 days	Cool to 4°C
3	1	1	1	--	6	1,2,3,4,5	V	TCL B/N/A E and Aniline	CLP-SAS	CLP Protocol	1, 80-oz amber glass	6	7 days to extraction; 40 days after	Cool to 4°C
3	1	1	1	--	6	1,2,3,4,5	IV	TAL Metals	CLP-RAS	CLP Protocol	1, 1-liter plastic bottle	6	6 months; Hg-28 days	HNO_3 to pH<2; Cool to 4°C
31	2	2	2	--	37	1,2,3,4,5	IV	Total Arsenic, Iron(unfiltered)	CLP-SAS	CLP Protocol	1, 1-liter plastic bottle	37	6 months	HNO_3 to pH<2; Cool to 4°C
28	2	2	2	--	34	1,2,3,4,5	IV	Iron, Arsenic (filtered)	CLP-SAS	CLP Protocol	1, 1-liter plastic bottle	34	6 months	HNO_3 to pH<2; Cool to 4°C
31	2	2	2	--	37	1,2,3,4,5	V	Aniline	CLP-SAS	CLP Protocol	1, 80-oz amber glass	37	7 days to extraction; 40 days after	Cool to 4°C
34	2	--	--	--	36	1,4,5	III	Hardness	REM III-RAS	EPA 310.1	1, 1-liter plastic bottle	36	14 days	Cool to 4°C
34	2	--	--	--	36	1,5,4	III	Suspended Solids	REM III-RAS	EPA 160.2	1, 1-liter plastic bottle	36	NA	NA
34	--	--	--	--	34	1,4,5	I	pH; Eh; Temperature, Specific Conductance, Dissolved Oxygen	Field Analysis	Primary Specific Ion Electrode	NA	NA	NA	NA
28	2	2	2	--	34	1,4,5	III	Nitrate/Nitrite	REM III-SAS	EPA 300.0	1, 1-liter plastic bottle	34	14 days	Cool to 4°C
34	2	--	--	--	36	1,4,5	III	Alkalinity	REM III-SAS	EPA 130.1	(v)	36(v)	14 days	Cool to 4°C
30	2	2	2	--	36	1,2,3,4,5	IV	Arsenic (unfiltered)	CLP-SAS	CLP Protocol	1, 1-liter plastic bottle	36	6 months	HNO_3 to pH<2; Cool to 4°C

TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
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Matrix - Sediments

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements		Holding Time	Preservation Requirements
											Per Sample	Total		
3	1	1	--	1	6	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	2, 120-ml wide-mouth glass jars	12	7 days	Cool to 4°C
3	1	1	--	--	5	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	5	7 days to extraction; 40 days after	Cool to 4°C
3	1	1	--	--	5	1,2,3,4,5	IV	TAL Metals	CLP RAS	CLP Protocol	1, 8-oz wide-mouth glass jar	5	6 months; Hg-28 days	Cool to 4°C
17	1	1	--	--	19	1,2,3,4,5	IV	Total Arsenic, Iron	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	19	6 months	Cool to 4°C
11	1	1	--	--	13	1,2,3,4,5	IV	Aniline	CLP-SAS	CLP Protocol	1, 8-oz wide-mouth glass jar	13	7 days to extraction	Cool to 4°C
20	--	--	--	--	20	1,4,5	III	pH	REM III SAS	SW 9045	1, 8-oz wide-mouth glass jar	20	NA	NA
20	1	--	--	--	21	5,4,1	III	Total Organic Carbon	REM III-RAS	CASWS P3-65	1, 8-oz wide-mouth glass jar	21	28 days	Cool to 4°C
20	--	--	--	--	20	1,2,3,4	III	Grain Size	REM III-SAS	ASTM D 422-63	1, 8-oz wide-mouth glass jar	20	NA	NA

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
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Matrix - Sediments (Continued)

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Bottle Requirements		Holding Time	Preservation Requirements
											Per Sample	Total		
11	1	1	--	1	14	4,1,2,3,5	IV	PCE	CLP-SAS	CLP Protocol	2, 120-ml wide-mouth glass jars	28	7 days	Cool to 4°C
20	--	--	--	--	20	1,4,5	III	Eh	REM III-SAS	ASTM D 1498-76	1, 8 oz wide-mouth glass jar	20	NA	NA

Matrix - Fish Tissue (Whole Body)(u)

8	1	--	--	--	9	2,1	V	Arsenic	CLP-SAS	CLP Protocol	1, 8-oz glass jar		NA	Cool to 4°C

Matrix - Fish (Edible Tissue)(u)

8	1	--	--	--	9	2,1	V	Arsenic	CLP-SAS	CLP Protocol	1,8-oz glass jar		NA	Cool to 4°C

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE

(a) Data use list has been prioritized:
1 Site Characterization
2 Risk Assessment
3 Evaluation of Alternatives
4 Engineering Design of Alternatives
5 Modeling Input

(b) Analytical sensitivity achieved by the proposed analytical method is acceptable for the data uses and objectives.
(c) Residential wells only.
(d) Includes chloride, fluoride, nitrate-N, nitrite-N, orthophosphate-P, and sulfate.
(e) All CLP analyses for waste samples can be performed with 8-oz. of material. Pack jar in paint can for shipment.
(f) Air samples collected per request of Health and Safety Officer for Whitmoyer Site. Aniline air samples will be collected in Buildings 1, 2, 3, 6, and 7. Methyl bromide, samples will be collected in Building 5.
(g) Three soil borings/2 or 3 samples per boring, as follows: top 3 inches; bottom 1.5 feet; and possibly 1 opportunity sample.
(h) CLP protocol for high level samples. Pack samples in paint cans for shipment.
(i) 51 Federal Register 40572 (to be codified at 40 CFR 268, Part I)
(j) Can be performed with the same thin-wall tube sample.
(k) Actual number of samples will be based on a density of 1 every 2,500 square feet.
(l) Samples to be collected with split barrel sampler, at a density of 1 sample every 2,500 square feet, if thin-wall tube cannot be used. Permeability sample will be prepared to average field density as measured by ASTM D 2922-81 and sent for analysis.
(m) Same sample jar as grain size.
(n) Samples to be collected with split barrel sampler at a density of 1 sample every 2,500 square feet, if thin-wall tube cannot be used.
(o) One test pit per lagoon/2 or 3 samples per test pit. One sample per every other pit analyzed for TCL, TAL. Other samples analyzed for arsenic and iron only.
(p) Seven borings/2 or 3 samples per boring.
(q) Pack in paint cans for shipment.
(r) Same sample bottle as BTU content.
(s) Liquid samples.
(t) Includes opportunity sample.
(u) Fish tissues sample assay conducted at 8 locations: 1 upstream location, 4 downstream locations, and 3 downstream lakes.
(v) Same sample bottle as COD.
(w) Same sample bottle as hardness.
(x) Unknown drum samples only.
(y) Solids samples only.
(z) Same sample jar as arsenic.

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TABLE 3-6
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE
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ASTM	American Society for Testing Materials.
CLP	Contract Laboratory Program.
CLP Protocol	Protocols defined in the CLP Statement of Work, latest revision (CLP-RAS: Routine Analytical Services)
CLP-SAS	Special Analytical Services (SAS) requiring specified preparation, analysis or reporting techniques which are available through the CLP. CLP-SAS requires coordination with SMO.
EPA	Methods for Chemical Analysis of Water and Wastes, March 1983.
NA	Not Applicable.
SM	Standard Methods for the Examination of Water and Wastewater, 16th edition.
SW	Test Methods for Evaluating Solid Waste (SW-846), 3rd edition, November 1986.
NIOSH	National Institute of Occupational Safety and Health
CASWS	Procedure for Handling and Chemical Analysis of Sediment and Water Samples EPA/CE-81-1
TAL	Target Analytes List (formerly the HSL).
TCL	Target Compound List (formerly the HSL).
TOC	Total Organic Carbon.
REM III-RAS	A REM III Team laboratory will be performing the analysis. The analysis required is one of the 101 tests considered as routine analysis by REM III laboratory. REM III-RAS requires coordination with Ebasco.
REM III-SAS	A REM III Team laboratory will be performing the analysis. The analysis required is NOT one of the 101 tests considered as routine analysis. REM III-SAS requires coordination with Ebasco.
Field Duplicate	A single sample split into two portions and both are submitted blindly to the laboratory. The duplicate set serves as an oversight function in assessing the precision of the overall sampling, handling and analytical program. NOTE: In the EPA DQO guidance document, Field Duplicates are referred to as Replicate Samples.
Bottle Blank	Samples which are obtained by directly pouring analyte-free, deionized water into a sample collection bottle. They serve as an oversight function in assessing the effect of residual contamination in the sample collection bottle.
Trip Blank	Trip blanks are prepared prior to the sampling event in the actual sample containers and are kept with the investigation samples throughout the sampling event. Trip blanks must be submitted with each batch (i.e., daily) of samples submitted for VOA analysis. They are used to monitor the loss (or gain) in the VOA fraction associated with routine sample handling.
Field Blank	Samples which are obtained by running analyte-free deionized water through sample collection equipment (bailer, pump, auger, etc.) after decontamination. These samples are used to monitor the effectiveness of equipment decontamination procedures.

3.3.1 Preliminary Activities

Two tasks have been identified that should be performed prior to the onset of drilling/excavation/sampling activities at the site. The two tasks are

- Existing monitoring-well evaluation
- Fracture trace analysis

These tasks must be performed prior to beginning subsurface investigative work at the site so as to maximize the efficiency and effectiveness of the site investigation.

The existing monitoring well evaluation is required in order to determine which of the wells that were installed during previous site studies are available for use during the RI/FS for sampling and/or water-level measurements, and to determine whether quarry pumping west of the site is currently altering groundwater flow directions beneath the site. There is no information available describing the current condition of the wells on and around the site. The well evaluation will consist of observing the physical condition of each monitoring well and obtaining water levels from the wells wherever possible. Water-level elevations will be plotted on a base map of the site to determine present groundwater flow directions in the site vicinity. The proposed monitoring well locations will be re-evaluated, based on the updated information regarding flow direction, and adjusted as necessary (with EPA concurrence). Details regarding the existing monitoring-well evaluation procedures are presented in Section 4.3.1.

A fracture trace analysis is proposed as a supplemental tool for the siting of monitoring wells. Fracture traces can indicate zones of relatively high permeability and thus preferred groundwater migration pathways. Meisler (1963) reported that a fracture trace study had been performed for the Lebanon Valley in which the lineaments identified did not show a significant correlation with high-yielding wells; however, a positive correlation between fracture traces and relatively high yielding wells has been well established and widely accepted on an overall basis. The fracture trace analysis will be focused on the local area surrounding the site, with adjustments made to proposed well locations based on the results (with EPA concurrence). Since fracture trace analysis only identifies major near-surface features, deeper or smaller solution fracture/channel zones that are commonly present are not identified. Because these permeable zones can be expected at most drilling locations and can be important groundwater migration pathways, major deviations from proposed well locations (which are based on source area locations and groundwater flow directions) will not be made. Instead, minor adjustments will be considered for fracture traces located near source areas, with more substantial well location adjustments considered for offsite wells where precise positioning is not critical. Details of the proposed fracture trace analysis are provided in Section 4.3.1.

3.3.2 Vault Investigation

WLI company reports indicate that the vault contains 3.75 to 4 million pounds of arsenic, mostly in the form of calcium arsenate sludge. Additionally, drums containing aniline still bottoms and arsenic-bearing charcoal are reportedly present there. Observed periodic fluctuations in water-level measurements (up to 2.75 feet) taken from the vault draw tubes over time indicate that the vault may be cracked and open to the environment. In addition to arsenic, a groundwater sample taken from the borehole placed just north of the vault contained trans-1,2-dichloroethene, methylene chloride, PCE, TCE, and phenols.

The data needs for the vault investigation are presented in Table 3-3. To meet these needs, an RI vault investigation program has been developed. This program is shown in Table 3-5. As can be seen, samples of the vault contents will be collected from two borings drilled into the vault wastes. One sample from each boring will be taken from the contaminated soil (and drum leakage) overlying the 8-foot-thick, bottom layer of calcium arsenate sludge; a second sample from each boring will be collected from the sludge itself. These samples will also be subjected to treatability tests, if appropriate. A well point will be completed into the base of the vault waste as a piezometer for water level measurement and tracer introduction.

Four monitoring wells will be placed at three locations around the vault perimeter, for chemical sampling (MW-100A, MW-100B, MW-101A, and MW-102A) (see Figure 3-1). These wells will also be used for detecting a tracer introduced into the vault to help determine whether the vault is leaking. The tracer, lithium, will be introduced into the vault via the well point or borings. The tracer study, along with evaluating water level fluctuations inside and outside the vault, is designed to help determine whether the vault washes are in communication with the groundwater outside the vault due to cracks or holes within the vault. The detection of tracer outside the vault will provide concrete evidence to verify that the vault is leaking. Table 3-7 summarizes the proposed well installation program for the vault. Three soil borings will be drilled adjacent to the monitoring-well locations to provide soil samples for chemical analysis. Samples from these borings will be used to assess the level of contamination in soils adjacent to the vault (See Figure 3-2).

3.3.3 Consolidated Lagoons Investigation

The consolidated lagoons reportedly contain 400,000 pounds of arsenic in the form of ferric arsenate sludge. The lagoons are believed to be lined only with soil; groundwater reportedly contacts the sludge at least part of the time. Due to the

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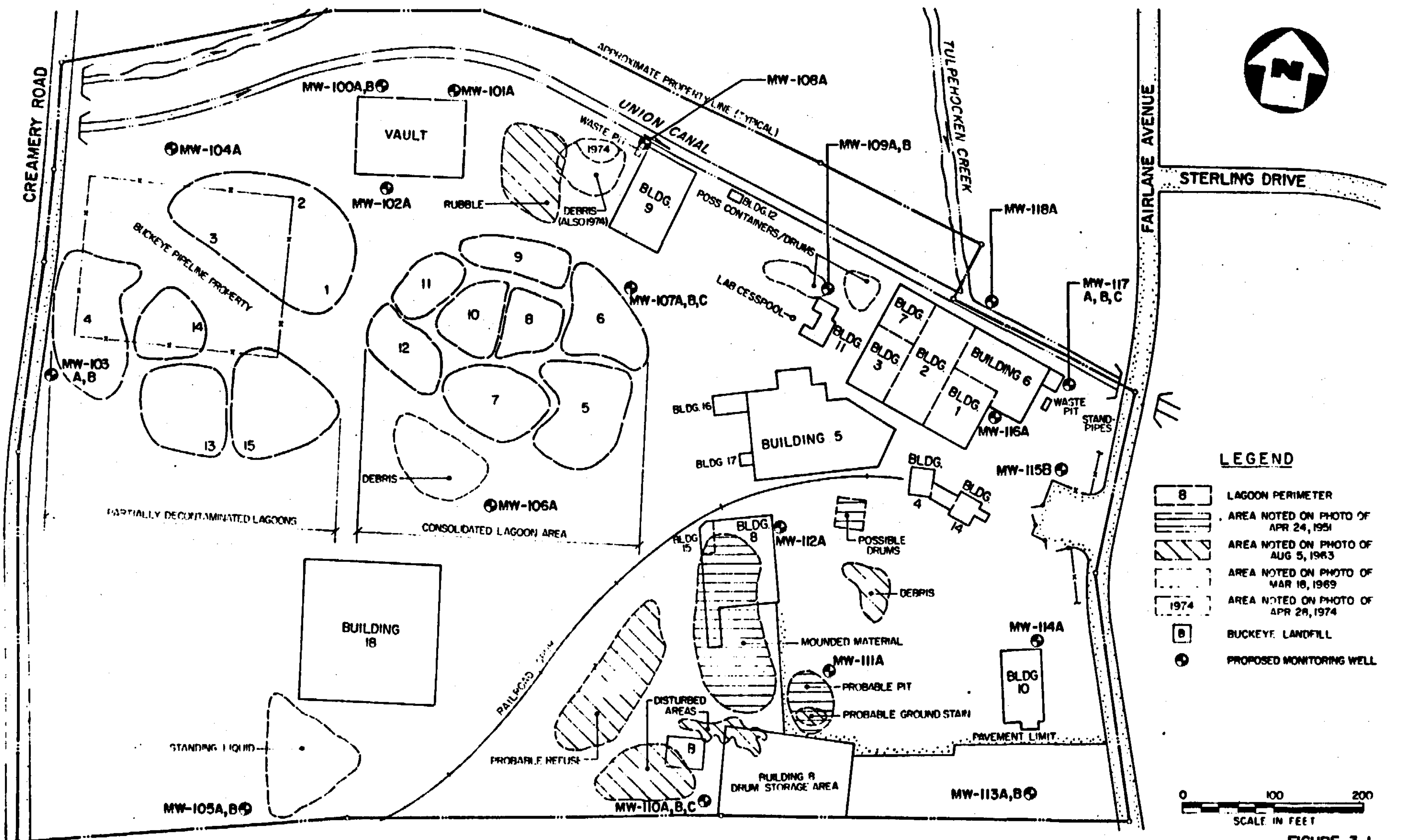

FIGURE 3-1

PROPOSED ONSITE MONITORING WELLS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

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TABLE 3-7

PROPOSED ONSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE

Well No.	Depth	Const. Type	Purpose										Notes
			Vault Invest.	Lagoon Invest.	Process Bldgs. Invest.	Misc. Storage/ Dumping Area Invest.	Water Quality	Shallow GW Flow Directions	Vertical Gradients	SW/GW Inter-actions	Deep GW Flow Directions		
MW-100A	S	PVC	X				X	X	X	X			Along north wall of vault, near standpipe with maximum water-level fluctuations. Determine leakage from vault in NW vault corner.
MW-100B	M	OB	X				X		X	X			Adjacent to MW-100A; deeper water quality. Determine vertical flow gradient near vault and canal.
MW-101A	S	PVC	X				X	X		X			Along north wall of vault, east of MW-100A and MW-100B; water quality downgradient of vault, local flow directions. Determine leakage fro vault in NE corner.
MW-102A	S	OB	X				X	X					Along south wall of vault; water quality upgradient of vault, local flow directions. Determine contaminant contribution to groundwater flowing under the vault from lagoons.
MW-103A	S	OB		X			X	X	X				West of western lagoon area; water quality along west edge of site; influence of quarry pumping.

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TABLE 3-7
PROPOSED ONSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
PAGE TWO

Well No.	Depth	Const. Type	Purpose										Notes
			Vault Invest.	Lagoon Invest.	Process Bldgs. Invest.	Misc. Storage/ Dumping Area Invest.	Water Quality	Shallow GW Flow Directions	Vertical Gradients	SW/GW Inter-actions	Deep GW Flow Directions		
MW-103B	M	OB		X			X		X				Adjacent to MW-103A. Check for influence of quarry pumping deeper in aquifer, water quality.
MW-104A	S	OB		X			X	X		X			Downgradient of western lagoon area.
MW-105A	S	OB				X	X	X	X				In southwest corner of property, near area of standing liquid in 1969 photograph.
MW-105B	M	OB				X	X		X				Adjacent to MW-105A. Determine vertical gradients and deeper groundwater quality.
MW-106	S	OB		X			X	X					Upgradient of eastern lagoon area; paired with existing well No. 1 to provide shallow/medium depth well cluster.
MW-107A	S	OB		X			X	X	X				Downgradient of eastern lagoon area. Determine shallow groundwater contamination.
MW-107B	M	OB		X			X		X				Adjacent to MW-107A. Determine vertical distribution of contamination, vertical flow gradients.

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TABLE 3-7
PROPOSED ONSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
PAGE THREE

Well No.	Depth	Const. Type	Purpose										Notes
			Vault Invest.	Lagoon Invest.	Process Bldgs. Invest.	Misc. Storage/ Dumping Area Invest.	Water Quality	Shallow GW Flow Directions	Vertical Gradients	SW/GW Inter-actions	Deep GW Flow Directions		
MW-107C	D	OB		X			X		X		X		Adjacent to MW-107A and MW-107B. Determine vertical distribution of contaminants, vertical flow gradients, deep groundwater flow directions.
MW-108A	S	PVC			X		X	X		X			Downgradient of Building 9 (maintenance garage) and related cesspool. Check for building-related groundwater contamination.
MW-109A	S	OB			X		X	X	X	X			Downgradient of Building 11 and laboratory cesspool. Primary focus on releases from laboratory cesspool.
MW-109B	M	OB			X		X		X	X			Adjacent to MW-109A; deeper water quality in potential former localized recharge area (cesspool); vertical gradients.
MW-110A	S	OB				X	X	X	X				Along south edge of site; upgradient water quality. Check for induced migration to south due to pumping of industrial well 1,500 feet south of site.

TABLE 3-7
PROPOSED ONSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
PAGE FOUR

Well No.	Depth	Const. Type	Purpose										Notes
			Vault Invest.	Lagoon Invest.	Process Bldgs. Invest.	Misc. Storage/ Dumping Area Invest.	Water Quality	Shallow GW Flow Directions	Vertical Gradients	SW/GW Inter-actions	Deep GW Flow Directions		
MW-110B	M	OB				X	X		X				Adjacent to MW-110A. Determine vertical gradients in south site area. Check for induced flow to south.
MW-110C	D	OB				X	X		X		X		Adjacent to MW-110A. Deep groundwater quality; will be used with MW-107C and MW-117C to determine deep groundwater flow directions.
MW-111A	S	OB				X	X	X					Downgradient of drum storage area and potential waste dumping/burial area, which are two significant potential sources of contamination.
MW-112A	S	OB			X	X	X	X					South of Building 8 and potential waste disposal/burial area.
MW-113A	S	OB				X	X	X	X				South of Building 10. Located between process buildings area and residential wells south of site containing high levels of contaminants.

TABLE 3-7
PROPOSED ONSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
PAGE FIVE

Well No.	Depth	Const. Type	Purpose										Notes
			Vault Invest.	Lagoon Invest.	Process Bldgs. Invest.	Misc. Storage/ Dumping Area Invest.	Water Quality	Shallow GW Flow Directions	Vertical Gradients	SW/GW Inter-actions	Deep GW Flow Directions		
MW-113B	M	OB			X	X	X		X				Adjacent to MW-113A. Check for potential for deeper contaminants to be migrating south to residential wells due to pumping of industrial well south of site.
MW-114A	S	OB			X		X	X					Downgradient of Building 10, upgradient of existing well No. 7 (highly contaminated).
MW-115B	M	OB				X	X		X				Adjacent to existing well No. 7. Determine deeper groundwater quality, vertical gradient.
MW-116A	S	OB				X	X	X	X				Adjacent to existing well No. 4 (315-foot-deep wastewater injection well; highly contaminated). Determine shallow groundwater quality.
MW-117A	S	PVC			X	X	X	X	X	X			Downgradient of waste pit located Adjacent to Building 6; major potential source area for arsenic and organics.
MW-117B	M	OB			X	X	X		X	X			Adjacent to MW-117A. Check for vertical migration of contaminants (waste pit may have been a local groundwater recharge area during past operations).

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TABLE 3-7
PROPOSED ONSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
PAGE SIX

Well No.	Depth	Const. Type	Purpose										Notes
			Vault Invest.	Lagoon Invest.	Process Bldgs. Invest.	Misc. Storage/ Dumping Area Invest.	Water Quality	Shallow GW Flow Directions	Vertical Gradients	SW/GW Inter-actions	Deep GW Flow Directions		
MW-117C	D	OB			x	x	x		x	x	x		Deep groundwater quality downgradient of both waste pits and deep injection well (well No. 4), combined with MW-107C and MW-110C to determine deep groundwater flow directions.
MW-118A	S	PVC			x		x	x		x			Downgradient of Buildings 1, 2, and 6 (major chemical processing buildings); may have to be placed across canal from buildings because of access restrictions.

S Shallow
M Medium
D Deep

SW Surface Water
GW Groundwater

OB Open Borehole Monitoring Well
PVC PVC Monitoring Well

30 MW's Onsite.

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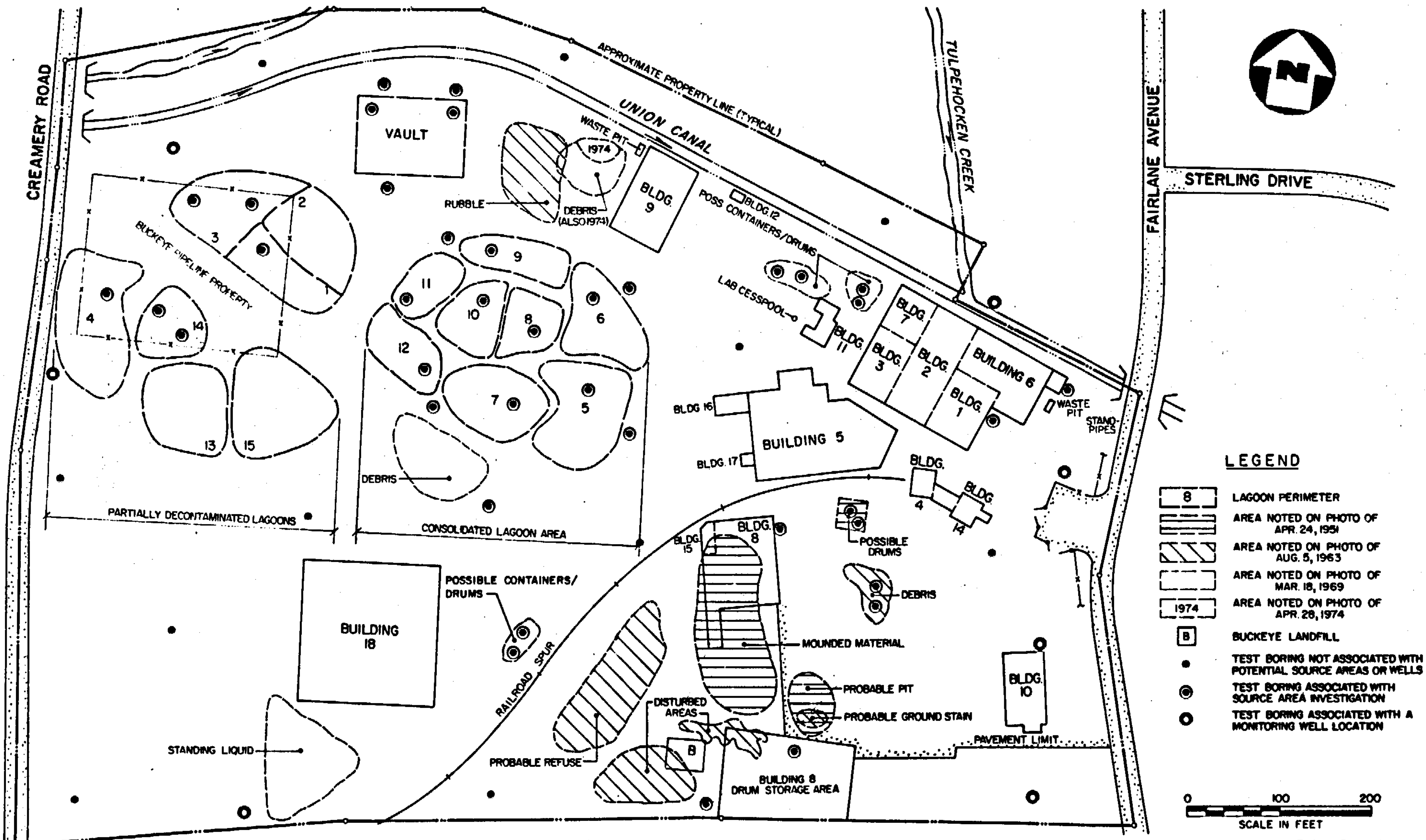

FIGURE 3-2

NUS CORPORATION

PROPOSED ONSITE TEST BORING LOCATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

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volume of wastes present and the questionable storage practices, these lagoons may be a primary source area for present contaminant releases.

The risk assessment and engineering needs for the vault investigation are presented in Table 3-3. To obtain the requisite data, a consolidated lagoons RI investigative program has been developed. The proposed RI program is shown in Table 3-5. One test boring per lagoon will be drilled and sampled to obtain subsurface samples of the sludge material within the lagoons. Data from these samples will be used to estimate the level of contaminants in the sludge materials and spatial variation of these levels. Additionally, five boreholes will be placed around the lagoon perimeter to confirm the lagoon limits and permit soil sampling near the lagoons. Data from these boring samples will be combined to assess the level of contamination in soils adjacent to these lagoons.

A total of five monitoring wells will be installed at three locations around the perimeter of the consolidated lagoons area (MW-102A, MW-106A, MW-107A, MW-107B, and MW-107C, Figure 3-1). The wells will be located and designed to provide data regarding the vertical and horizontal extent of contamination in the consolidated lagoon area. As the lagoons at one time presumably held liquids, the potential for significant vertical contaminant migration exists and will be assessed. Details regarding the rationale behind the proposed monitoring well configuration are presented in Table 3-7.

Lysimeters will be installed directly into the lower portion of the sludge material at four of the boring locations and sampled to measure in-situ leachability. Determine the cumulative effect of the wastes on groundwater migrating downward through the wastes in the unsaturated zone. Lysimeter samples will provide data with which to determine the chemical quality of the water that has migrated through lagoon wastes, prior to entering the saturated zone. Additionally, select sludge samples will be analyzed using the TCLP test protocol to determine whether the material is a "hazardous waste."

Laboratory permeability tests will be performed on the lagoon cap material and liner, as well as the sludge material itself. The permeability test results will be used to estimate the rate of precipitation infiltration through the lagoons and the degree of interconnection between lagoon wastes and groundwater. Additionally, consolidation and strength characteristic tests will be performed on the sludge to determine bearing capacities of the lagoon surfaces. This data will be used in assessing remediation techniques which may involve increasing the load on the lagoon surfaces. Finally, the sludge may be subjected to treatability tests, if warranted.

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3.3.4 Excavated Lagoons Investigation

The western (excavated) lagoons were used to hold sludge containing approximately 200,000 pounds of arsenic. Former workers at Whitmoyer Laboratories Site indicate that the western lagoon sludge was excavated to bedrock and placed atop the eastern lagoons. Only minor amounts of sludge were left at the western lagoon site. Two primary concerns are associated with the excavated lagoons. First, residual sludge may be present in these lagoons. If present, this sludge could leach contaminants into groundwater. Second, the former lagoon operations could have caused soils adjacent to the lagoons to become elevated in arsenic concentrations. Table 3-3 presents the risk and engineering data needs for the excavated lagoons investigation.

The investigative approach for the excavated lagoons is shown in Table 3-5. To ensure that little if any residual sludge is present in the excavated lagoons, a test pitting and soil boring program has been designed, calling for two test pits or test borings per lagoon. Test pits will be used where possible, as they provide the best means to find discrete waste deposits where exact locations are unknown. Soil borings will be drilled into the former lagoons on the Buckeye Pipeline property to minimize soil disturbance there. The bottoms of all test pits and soil borings into the former lagoons will be filled with a 1-foot life of bentonite to minimize the effects of the sampling program (bentonite was reportedly placed in the bottoms of the lagoon excavations). Three test pits will be placed around the lagoon perimeters to permit soil mapping and sampling adjacent to the former lagoons (see Figure 3-3).

Four monitoring wells will be placed in three locations around the perimeter of the former lagoons (MW-102A, MW-103A, MW-103B, and MW-104A-see Figure 3-1). The four wells will be used to assess the degree of contamination of groundwater in the excavated lagoon area and to provide water-level information for the western portion of the site. Information regarding water levels will be useful on both a site-specific basis and for assessing the influence of quarry pumping on the site. Details of the proposed well objectives and rationale are presented in Table 3-7.

3.3.5 Process Buildings Investigation

The process buildings are the site of former chemical production, waste evaporation, and product storage. The condition of the process buildings is largely unknown. Since the facility was never closed under RCRA, there is a concern that residual contamination may be present in the buildings. A strong chemical odor was noticed when Building 1 was entered briefly on January 29, 1988. On the same date, large quantities of laboratory wastes were observed in Buildings 2 and 8. Possible asbestos materials were noticed on the ceilings of some of the buildings. Finally, WLI company files contain reports of runoff from roof drains containing elevated levels of arsenic.

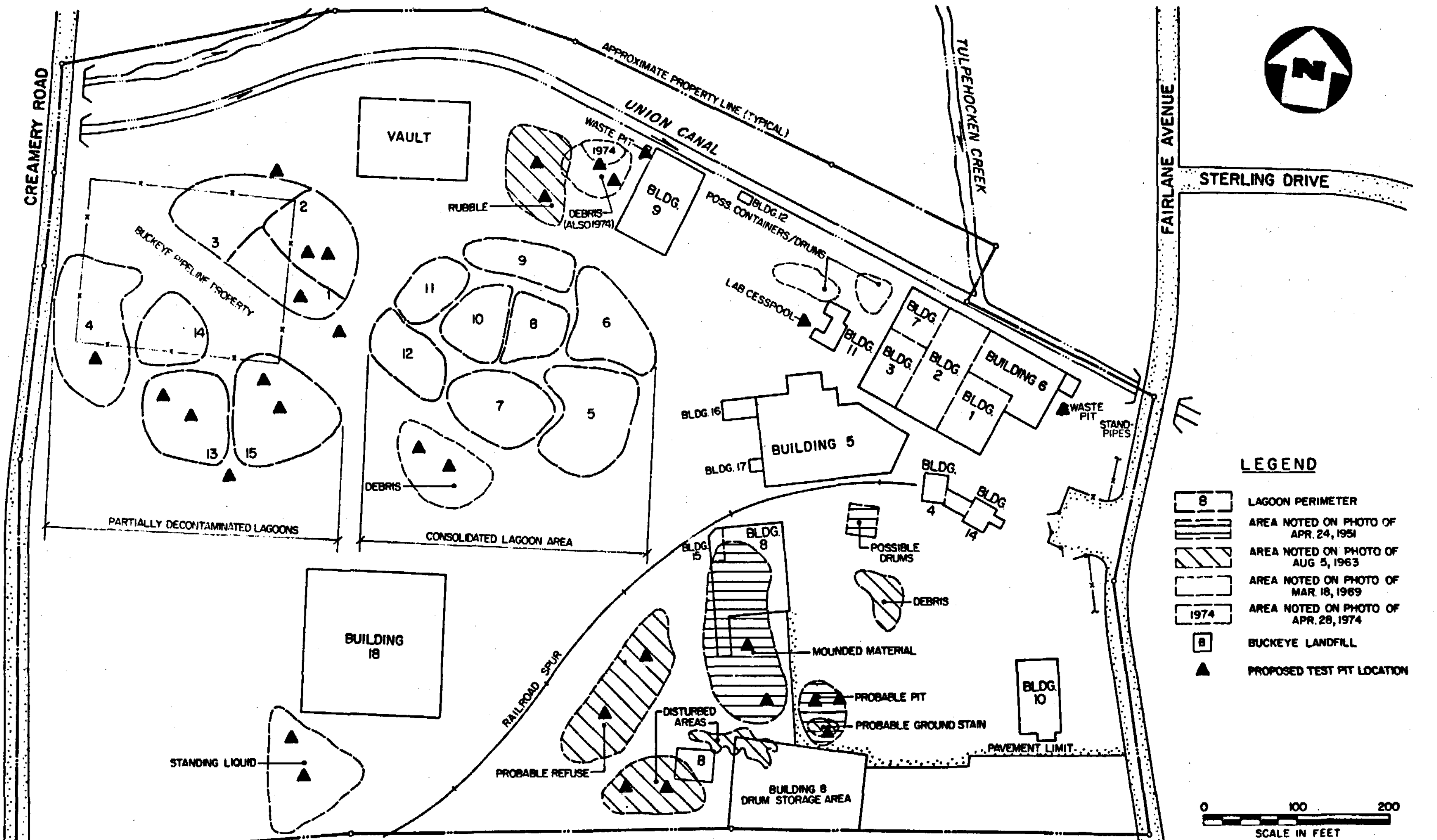

FIGURE 3-3

NUS CORPORATION

PROPOSED TEST PIT LOCATIONS

WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

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One building, Building 18, is presently being used as a food warehouse. This building, the newest onsite, was only used as a warehouse by Whitmoyer. Since this building is the subject of review of other regulatory agencies (because of the food storage), only a walkthrough inspection is planned there.

There is a concern that residual chemicals from production and storage may be present in the remaining buildings, both in the vapor and particulate form. Additionally, residual liquids from production may be present in the process equipment and piping. Finally, there are full containers (drums, etc.), in addition to the laboratory containers, present in the buildings (as of May 17, 1988). Human exposure from inhalation/ingestion and direct contact is possible.

The data needs for the process buildings investigation are presented in Table 3-3. The process buildings investigative program is shown in Table 3-5. The first activity in the buildings will be air monitoring to establish the proper level of worker protection. Since both methyl bromide and aniline cannot be captured in chemical respiratory cartridges, the air levels in buildings where these chemicals were used will be established using stationary air monitors to determine whether supplied air is required for worker protection. This data will also be used for risk assessment. Other contaminant levels will be estimated using an HNU or organic vapor analyzer (OVA). Once the workers are properly outfitted, an inventory of the building equipment, including piping, building material, and stored chemicals, will be conducted.

After the inventory is completed, wipe samples of building floors, walls, and ceilings will be collected to establish the levels of chemicals available for dermal contact and inhalation/ingestion. Additional wipe samples will be collected near the building exhausts to determine whether contamination is present there. Samples will also be collected from suspected potential asbestos materials. If asbestos is found, the need for further sampling will be assessed.

To identify levels of equipment contamination, composite wipe samples from several pieces of equipment will be collected. Additionally, where practical, piping will be opened and sampled if liquids are present. The piping samples will be used to determine proper disposal requirements for these liquids. Liquids present in the piping will be collected in drums.

To determine if runoff from roof drains is still a problem, the roof drains will be sampled after a rainstorm. If no rain occurs during the sampling period, clean water will be sprayed on the building roofs to simulate a rain event.

A subcontractor will be procured to test the laboratory wastes for compatibility and bulk compatible wastes in drums. Once drums are full, they will be sampled for the parameters necessary to evaluate disposal options. An estimate of 100 drums of laboratory wastes has been derived for budgeting purposes.

The potential for seepage of process liquids through cracks in the floors existed. To determine whether soil adjacent to the buildings is contaminated, three borings will be drilled and soil samples taken. Monitoring wells will be installed adjacent to Buildings 1, 2, and 8 (monitoring wells MW-116A, MW-118A, and MW-112A, located in Figure 3-1) to assess the potential for releases from these buildings. One well will be installed adjacent to each building. A detailed description of the intended use and rationale for each well is presented in Table 3-7. In addition to the wells located adjacent to the process buildings, monitoring wells MW-115B, MW-113A, MW-144A and MW-113B will be installed along the eastern property boundary, near the process buildings. These wells are intended to provide general water-quality data for the eastern portion of the site. Soil samples will be obtained from test borings drilled adjacent to each well location, for chemical analysis.

If additional sampling or treatability testing is required for the process buildings, it will be completed during a later portion of the RI/FS.

3.3.6 Drums and Tanks Investigation

An estimated 600 full or potentially full drums are present on site. Additionally, it is unclear whether the wastewater or feedstock tanks on site are empty. Reportedly some of the wastewater tanks are still full. Liquid was observed leaking from the piping leading to one tank during both January 1988 site visits.

The data needs for the drums and tanks investigation are presented in Table 3-3. The investigative program is contained in Table 3-5.

The drums reportedly contain approximately 65 different types (or groups) of wastes, with the waste type clearly marked on the side of each drum. There are also 47 drums containing unknown materials on site.

The first part of the drum investigation will focus on determining if groups of drums marked as coming from the same waste stream are relatively homogeneous. This will be accomplished by sampling several drums from each group and comparing the samples. If the drum groups are not homogeneous, the sampling plan will be revised accordingly.

Once the drum group homogeneity has been established, samples from each group and from each drum of unknown origin will be field-analyzed for compatibility. After the compatibility tests have been conducted, the drums will be categorized into compatible categories likely to receive the same method

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treatment or disposal; e.g., water reactive solids. No physical movement of the drums will occur unless dangerous conditions exist.

After the drums have been categorized, aliquots from each drum or group of drums in a category will be combined based on volume percentages, it is anticipated that as many as 30 categories will be required for the 588 drums. These samples will be subjected to a suite of laboratory analyses, in order to evaluate their disposal options.

Both the wastewater and feedstock tanks will be sampled if liquids are present. The wastewater tank samples will be analyzed for the parameters necessary to evaluate disposal options, whereas the feedstock samples will only be analyzed for the reported feedstock chemical. Drum and tank quantities and waste volumes will be visually estimated. The drum and tank sampling results will be used to design proper disposal methods for the contents.

3.3.7 Waste Pit (Buildings 6, 9, and 11) Investigation

Waste pits located near Buildings 6, 9, and 11 were reportedly used for waste disposal in the early 1960s. The Building 6 pit was rebuilt, and continued to be used until plant closure. There is a concern that this disposal practice created "hot spots" of heavily contaminated soil. To test this hypothesis, a single test pit will be excavated at each of the Building 9 and 11 waste pit sites, whereas two test pits will be excavated near the Building 6 pit. If test pits are impractical at the Building 6 pit location, soil borings will instead be drilled. Two to three soil samples for chemical analysis will be collected from each test pit or boring, depending on observed subsurface conditions (depth to bedrock, wastes encountered, etc.). If significant contamination is found in the initial soil samples, the need for additional sampling at a later date will be assessed. Additionally, two monitoring wells will be installed at one location adjacent to the cesspool adjacent to Building 11 (MW-107A, MW-109B), three wells will be installed at one location adjacent to the Building 6 cesspool (MW-117A, MW-117B, and MW-117C), and one well will be installed downgradient of the cesspool at Building 9 (MW-108A). Multiple wells are proposed for the Building 6 and 11 cesspools, since these cesspools have been targeted as areas of particular concern, and data regarding both the vertical extent of contamination and vertical groundwater gradients near the Union Canal and Tulpehocken Creek are required to fully assess current groundwater quality conditions. Table 3-7 presents a detailed description of the rationale and intended purposes for these wells. Figure 3-1 shows the locations of the wells.

3.3.8 1951 Waste Pit Investigation

A probable waste pit was identified on a 1951 aerial photograph, as described in Section 2.0. The potential for waste material to be buried at or near this pit exists. A former worker reported encountering buried fiber drums in the vicinity of the waste pit while excavating with a backhoe. The data needs for the 1951 pit investigation are presented in Table 3-3. The investigative program is described in Table 3-5.

To determine whether any buried waste or contaminated soil is present in the pit vicinity, three test pits will be excavated. Three soil samples will be collected at selected intervals from each pit. If significant contamination is found in the initial test pit soil samples, the need for additional sampling at a later date will be reviewed. Monitoring well MW-111A is also located immediately downgradient of both the waste pit and the adjacent drum storage area, to provide water quality data for this area.

3.3.9 Photographic Anomalies Investigation

In addition to the probable 1951 pit, nine aerial anomalies were identified during an analysis of existing aerial photography. These anomalies include disturbed areas, standing liquid, probable refuse, mounded material, rubble, debris, and a probable ground stain.

To determine whether any residual contamination remains in the soils in these areas, up to two test pits will be excavated at each location that is unpaved, or two test borings will be drilled at each paved location. Soil samples will be collected at selected intervals from each excavation or boring. Sampling depths will be determined based on field observations made during drilling or on test-pit excavation activities. A total of two or three samples per boring or test pit will be submitted for analysis.

Monitoring wells will be installed adjacent to selected anomaly areas. Monitoring wells MW-105A and MW-105B are located next to an area of standing liquid identified in a 1969 photograph and will provide water-quality and water-level data for the southwest area of the site. Monitoring wells MW-110A, MW-110B, and MW-110C are located adjacent to a disturbed area identified from 1963 photographs and will provide water quality and water level data (including vertical head distributions) for the southern area of the site. Further information regarding the use of these wells is provided in Table 3-7, and well locations are shown on Figure 3-1.

If significant contamination is found in the initial soil and groundwater samples, the need for additional sampling at a later date will be assessed.

3.3.10 DDAA Storage Areas Investigation

Company files contain reports of two areas where diamino diphenyl arsonic acid (DDAA) was stored directly on the surface in the early 1960s. This practice may have created a "hot spot"

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in the soils at the former storage sites. Because of this concern, data needs have been developed for the DDAA storage areas. These needs are presented in Table 3-3. The investigative techniques developed to address these needs are contained in Table 3-5.

Two test pits will be excavated at each former storage site to determine soil conditions in these areas. Two or three soil samples will be collected at selected intervals from each pit. If significant contamination is found in the test pit samples, the need for additional sampling at a later date will be evaluated.

3.3.11 Drum Storage Area Investigation

Four drum storage areas (exclusive of the paved area north of Building 18), apparently located on top of soil, were identified in aerial photographs. There is the possibility that leaks and spills at these sites have created local "hot spots." The data needs and investigative techniques for the drum storage areas investigation are presented in Table 3-3 and Table 3-5, respectively. To assess the potential for waste spills/leakage to local soils, two soil borings will be drilled at each area. Two or three soil samples will be collected at discrete intervals from each boring. The need for additional sampling at a later date will be assessed if significant contamination is found in the soil samples.

3.3.12 Onsite Soils Investigation

There is a concern that the onsite surface soils away from the known and potential source areas may be enriched in arsenic from the waste evaporation stack emissions. These samples may present an inhalation/ingestion, direct contact, and/or surface runoff threat. Additionally, work performed by the USEPA TAT, USGS, and WLI demonstrated that onsite subsurface soils at the Whitmoyer Laboratories Site contain elevated levels of arsenic. These levels are believed to be due primarily to adsorption of arsenic present in groundwater. There is the potential for these soils to desorb arsenic (and possibly other contaminants) and to continue to contaminate groundwater. Data needs for the onsite soils investigation are presented in Table 3-3. The investigative techniques developed to meet these needs are described in Table 3-5.

Eighteen test borings will be drilled on site away from the source areas to evaluate surface and subsurface soil contamination. These borings are in addition to the test borings and test pits to be excavated at the source areas, and are placed to provide soil samples from areas on site not being investigated as source areas. Surface soil samples (0-3 inches) will be collected at all of the boring locations. Additionally, one or two subsurface soil samples per boring will be collected, depending on the soil thickness. Depth to bedrock will be the determining factor in deciding whether one or two subsurface

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samples are analyzed. If depth to bedrock is 6 feet or more, two samples will be analyzed. If depth to bedrock is less than 6 feet, only one sample will be analyzed. One sample from each borehole will be taken from directly on top of bedrock, with a second sample (if required) taken from a field-selected depth higher in the soil horizon. All of the soil samples will be submitted for chemical analysis. One sample from every other boring will be subjected for TCLP analysis to assess the leachability of the contaminants present in the soils. If significant soil arsenic concentrations are encountered, the need for particulate air monitoring or soil treatability testing will be assessed.

3.3.13 Offsite Soils Investigation

There are also concerns that waste evaporation stack emissions may have enriched offsite surface soil with arsenic, liquid waste discharges may have migrated downslope of the site along the soil/bedrock interface, and that adsorption of arsenic (and other contaminants) in groundwater may have increased subsurface soils contaminant levels off site. These soils may serve as sources for groundwater contamination via desorption. Additionally, the surface soils may present a threat via inhalation/ingestion, direct contact, or surface runoff. To address these concerns, data needs for an offsite soils investigation have been compiled (see Table 3-3) and an investigation program developed (see Table 3-5). Twenty-two offsite test borings are proposed, located as indicated in Figure 3-4. The borings are placed surrounding the site, with an emphasis on areas of the north and east, which are topographically downgradient of the site (in the direction groundwater in soils is likely to flow). One surface sample and one to two subsurface samples per soil boring will be chemically analyzed, depending on depth.

To evaluate the adsorption-desorption properties of soil at the site, five samples of soil believed to be "background" will be subjected to stirred reactor tests with contaminated groundwater from a site well. The partition coefficients for three contaminants, arsenic, aniline, and PCE, will be derived from these tests, if possible. Indicator chemicals, e.g., iron, TOC, and CEC, will be analyzed in order to enable partition coefficient derivation. These results will be compared to literature values as part of data evaluation and fate and transport modeling.

There is a concern that stack emissions from the waste evaporation system (Building 2) may have enriched surface soil off site in arsenic. Modeling results using atmospheric dispersion estimates from Turner (1970), the stack height, and Harrisburg wind rose data indicated that if this enrichment occurred, it would be seen primarily in the quadrant from northeast to southeast from the stack. Additionally, the maximum surface soil concentrations would be expected in the

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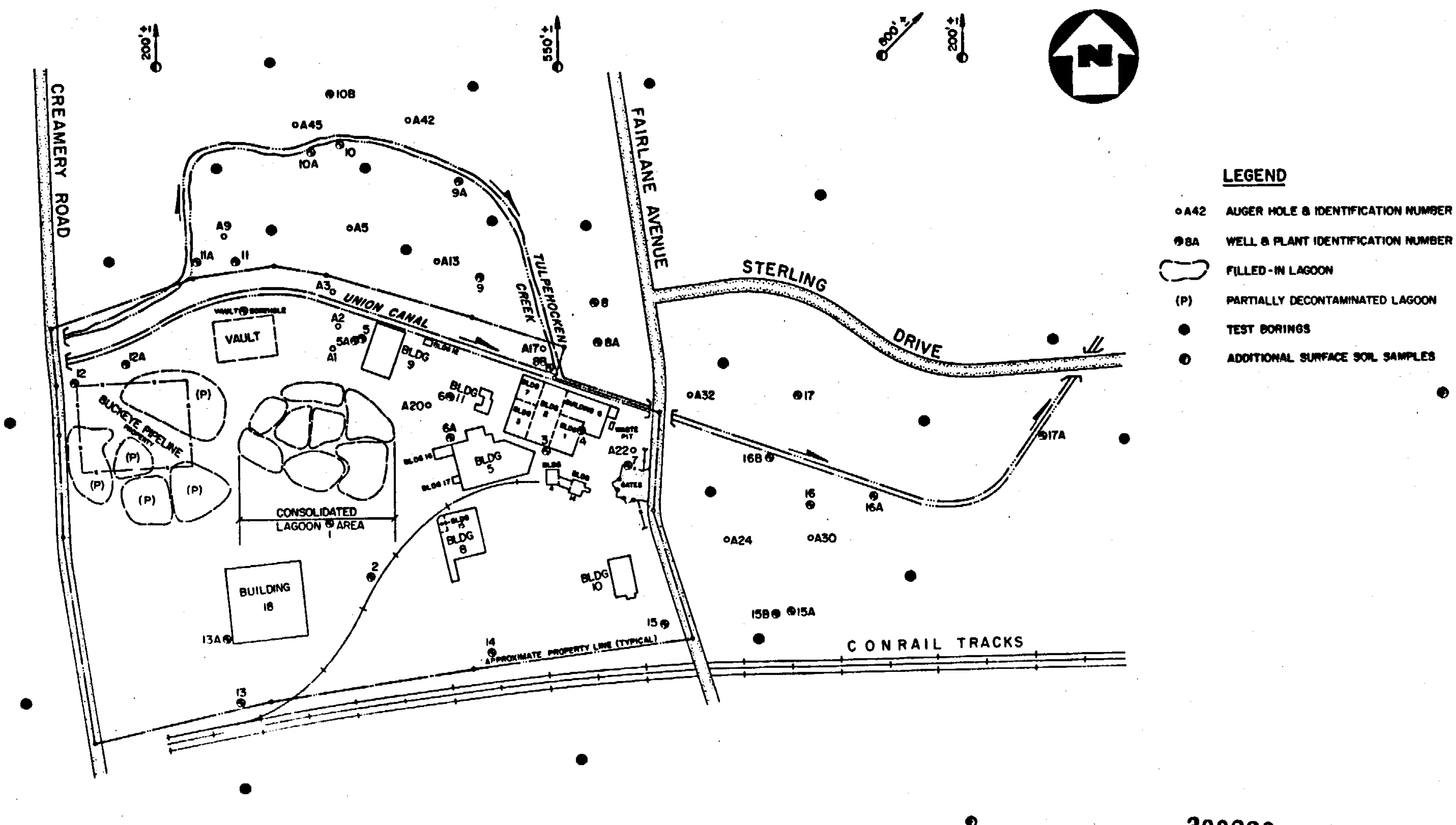

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FIGURE 3-4

NUS CORPORATION

PROPOSED OFFSITE TEST BORING LOCATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

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area 300 yards to 400 yards from the stack. To test this hypothesis, surface soil samples will be collected at all offsite test boring locations; six additional samples unrelated to the test borings will be collected, as shown on Figure 3-4.

The offsite surface soil sampling results will be analyzed to determine a significant pathway for inhalation/ingestion, dermal contact, and surface runoff exists. Also, the results will be analyzed to determine if they adhere to the Turner model and if the model describes the air-emissions-related soil contaminants plume well.

If significant contamination is found in the offsite soils, the need for additional sampling, air monitoring, treatability tests, and plant uptake studies will be evaluated.

3.3.14 Surface Water and Sediments

Historic data shows that the arsenic concentration in Tulpehocken Creek has increased as the creek (and Union Canal) passed the site. Similarly, sediment arsenic concentrations are higher downgradient of the site than upgradient. Neither surface water nor sediment have been analyzed rigorously for organics to date. The creek is used as a drinking water and irrigation source and for recreational fishing downgradient of the site.

Also, six lakes or quarries near Myerstown are fed by either groundwater, Tulpehocken Creek, or both. These lakes and quarries are all recreationally fished.

Blue Marsh Lake impounds Tulpehocken Creek approximately 16 miles downstream of the site. This lake serves as a primary drinking water source for western Berks County.

To measure the site contribution of contaminants to surface water and sediment, data needs have been developed (see Table 3-3) and a sampling program developed (see Table 3-5). The program calls for sampling creek water on up to three occasions, during high flow, low flow, and a rain event.

Surface water will be sampled at 14 locations along the reach from above the large quarry west of the site to Charming Forge Lake during both high and low flow periods, if possible. Sediment samples will be collected only during the second round of sampling. Table 3-8 lists the surface water and sediment sample locations.

The first sampling event will occur in the early stages of the field investigation. A second round of sampling will be performed during the late summer or early fall and compared with the results of the first round. The late summer-early fall timeframe was selected to have surface water/sediment sampling occur concurrently with benthic sampling.

TABLE 3-8

SURFACE WATER/SEDIMENT LOCATIONS AND RATIONALE
WHITMOYER LABORATORIES SITE

Station(1) Number	Description	Rationale
1(3,4)	Tulpehocken Creek at T-489 Bridge - Upstream	Determine background surface water/sediment quality
2(2,3)	Tulpehocken Creek at Ramona Road Bridge	Determine surface water/sediment quality as stream enters site
3(4)	Union Canal upstream of vault	Assess impact from site on reach from Station 2 to Station 3
4(4)	Union Canal at fish pond	Assess impact from site on reach from Station 3 to Station 4
5	Union Canal prior to confluence with Tulpehocken Creek	Assess impact from site on reach from Station 4 to Station 5
6	Tulpehocken Creek north of vault	Assess impact from site on reach from Station 2 to Station 6
7	Tulpehocken Creek north of stack	Assess impact from site on reach from Station 6 to Station 7
8(2,3,4)	Tulpehocken Creek at Fairlane Avenue Bridge	Assess impact from site on reach from Stations 5 and 7 to 8
9	Tulpehocken Creek at Race Street	Assess impact from site on reach from Station 8 to Station 9
10(2)	Tulpehocken Creek at College Avenue Bridge	Assess impact from site on reach from Station 9 to Station 10
11	Tulpehocken Creek above Sewage Treatment Plant (STP)	Assess impact from site or reach from Station 10 to Station 11
12	Tulpehocken Creek below STP	Assess impact of site (and STP) from Station 11 to Station 12
13(3)	Tulpehocken Creek Womelsdorf Bridge	Assess impact of site on reach from Station 12 to Station 13
14(3,4)	Tulpehocken Creek above Charming Forge Lake	Assess impact of site on reach from Station 13 to Station 14
15(4)	Charming Forge Lake	Assess impact of site on Charming Forge Lake
16(4)	Myerstown Pond	Assess impact from site
17(4)	Lakeside Quarry	Assess impact from contaminated groundwater

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TABLE 3-8
SURFACE WATER/SEDIMENT LOCATIONS AND RATIONALE
WHITMOYER LABORATORIES SITE
PAGE TWO

Station(1) Number	Description	Rationale
18	Wenger Quarry No. 1	Assess impact from contaminated groundwater
19	Wenger Quarry No. 2	Assess impact from contaminated groundwater
20	Abandoned Quarry west of site	Assess impact from contaminated groundwater

(1) Tulpehocken Creek station numbers can be cross-referenced with Figures 3-5 and 3-6.
(2) Surface water and sediment at these sites to be analyzed for TAL and TCL (BNA and VOA). Other than indicator parameters, all other surface water samples will only be analyzed for arsenic and iron, while all other sediment samples will only be analyzed for arsenic, iron, and aniline.
(3) A benthic macroinvertebrate study will be conducted at these sites.
(4) Fish will be captured and chemically analyzed at these sites.

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During the rain event, only two surface water stations near the site will be sampled. Thirty chemical samples (and water flow measurements) will be taken during the event, however, to assess temporal variation. These samples will serve as model input for overland transport models, which will be used to model surface runoff at the site. The sampling team will work closely with the National Weather Service in Harrisburg to ensure the rain event will meet the sampling objectives.

The six lakes and quarries will also be sampled once for surface water quality. Sediment samples will be collected from the two lake stations. The surface-water sample locations are shown in Table 3-8, as is the rationale for selecting the location. The sample locations are shown on Figures 3-5 (local) and 3-6 (regional).

Historical USGS precipitation records for the area will also be researched, in order to develop an understanding of precipitation patterns for the area. These patterns will also serve as input to the model.

To measure the effect on biota, if any, from the site, a benthic invertebrate inventory will be conducted along Tulpehocken Creek during late summer or early fall. Additionally, a fishery assessment, including fish tissue assay, will be conducted along the creek during the same timeframe. Finally, a wetlands delineation along the creek will be performed during late summer.

Five staff gauges will be installed at selected locations along Tulpehocken Creek and the Union Canal in the site vicinity. Additionally, staff gauges will be installed within local surface water bodies that are located adjacent to offsite monitoring well locations. The staff gauge measurements will be used to evaluate surface-water/groundwater interactions. Additionally, stream-flow measurement points will be set up at three locations along Tulpehocken Creek (one location upstream and two locations downstream of the site). In addition to the rain event samples, stream flow measurements will be taken during low flow and average flow conditions to help determine groundwater discharge rates in the site vicinity.

Once this program has been implemented, the need for additional sampling and treatability tests will be evaluated.

3.3.15 <u>Offsite Hydrogeologic Investigation</u>

Both onsite and offsite groundwater has been found to be contaminated with arsenic, PCE, and aniline. Additionally, onsite wells were found to be contaminated with benzene, chlorobenzene, ethylbenzene, chloroform, 1,1-dichloroethane, trans-1,2-dichloroethene, methylene chloride, toluene, TCE, phenols, acenaphthene, fluorene, fluoroanthene, naphthalene, phenanthrene, and pyrene. In addition to arsenic, industrial and residential wells near the site have been contaminated with

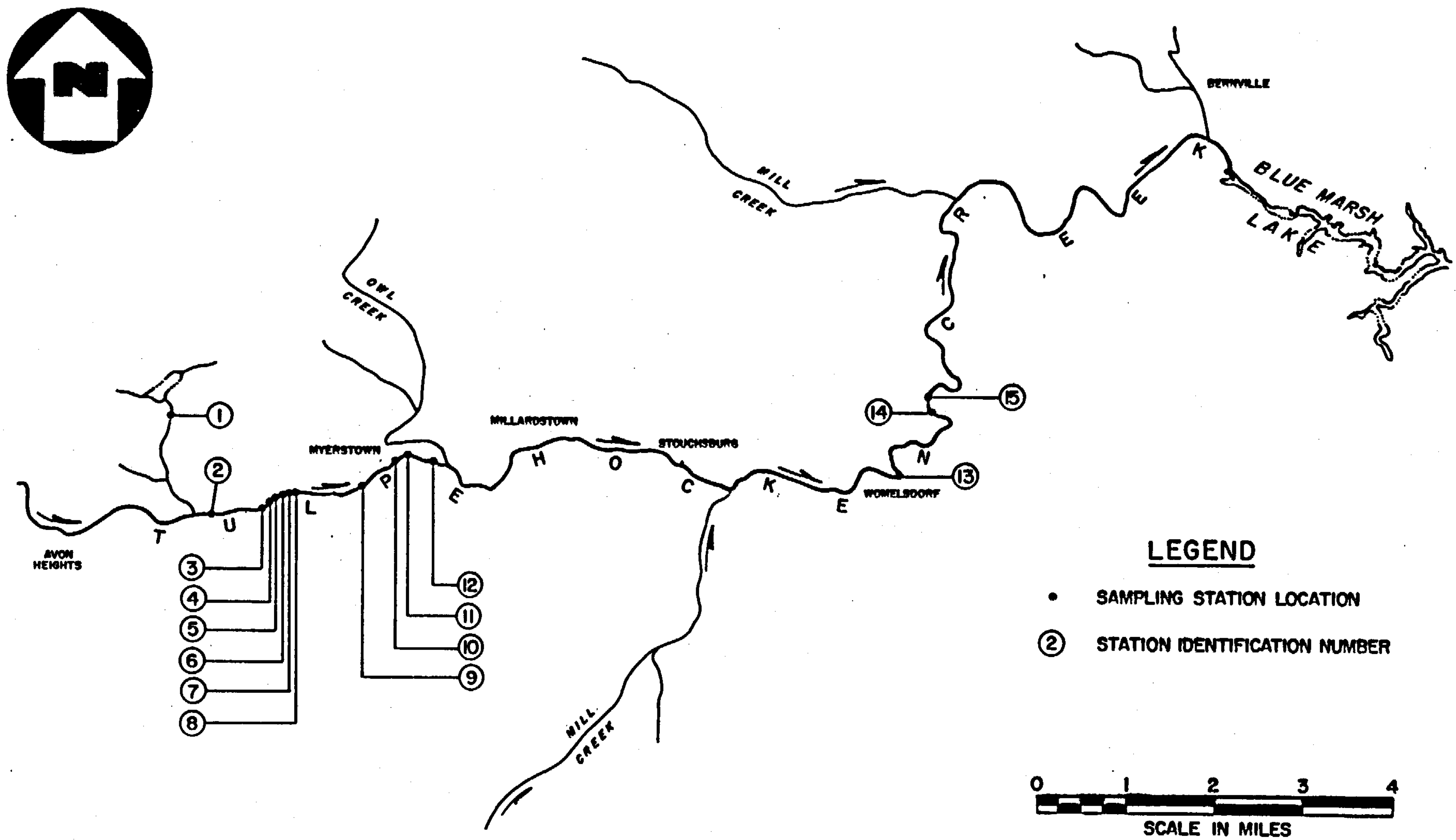

FIGURE 3-5

REGIONAL SURFACE WATER SAMPLING STATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

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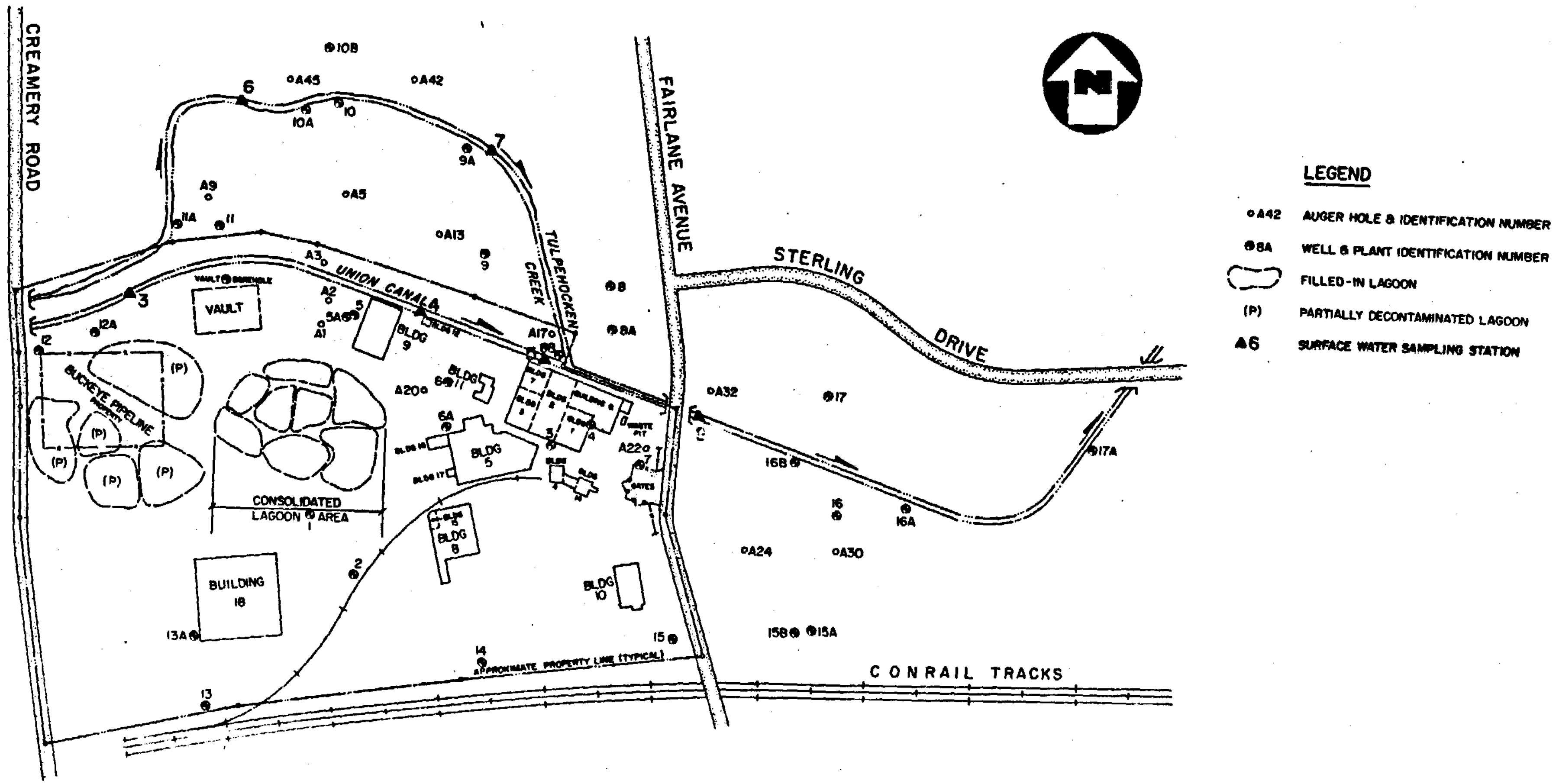

LOCAL SURFACE WATER SAMPLING STATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

FIGURE 3-6

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1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, trans-1,2-dichloroethene, cis-1,2-dichloroethene, PCE, TCE, toluene, and 1,1,1-trichloroethane (1,1,1-TCA). Very few of the residential wells have been analyzed for BNAs. It is unclear whether the organic contamination of the residential well is due to the site or to a separate offsite source.

An industrial complex south of the site, including the PJ Valves Plant (see Figure 2-8), is also suspected of being a source of 1,1,1-TCA contamination. No other known sources of arsenic contamination are known to exist in the Myerstown area. Other than the STP sludge, the nearest known source of arsenic is the Reyland Road CERCLA site near Womelsdorf.

A groundwater investigation program has been set up to assess offsite migration of contaminants and to identify areas where arsenic levels in groundwater exceed acceptable levels. The monitoring well installation program is described in more detail in Tables 3-5 and 3-9. The offsite groundwater investigation includes both the sampling of selected residential wells (eight), the rehabilitation of an estimated five existing wells and the drilling/installation/sampling of 17 monitoring wells at 8 locations in the local area (see Figure 3-7). Monitoring well locations were selected to provide information in areas where residential wells are not available for sampling, to help assess anomalous concentrations of contaminants in residential wells (south of the site), and to gauge the effect of regional hydrogeologic influences (quarry, lakes) on contaminant migration.

Two rounds of offsite groundwater sampling will be performed during the RI to provide an adequate data base to assess offsite groundwater quality. Results from the second round of sampling will be used to confirm the levels of contaminants detected in the first round.

3.3.16 Other Areas

Several other areas were identified during the data collection efforts (see Section 2.2.5). These areas include "the field," diked areas, and the sewage sludge. With the exception of the sewage sludge disposal points, the location of these points were never identified with any degree of confidence. In the event that these locations become known during the field work (or other unforeseen findings are made), a bank of opportunity samples is proposed to be set aside. The proposed bank includes 12 soil samples and 4 water samples. Utilization of these opportunity samples will be at the discretion of the RI leader. Additionally, the drilling subcontract will be written with charges based on a "unit-cost" basis to permit the drilling of additional holes if determined to be necessary. The flexibility provided by the bank of opportunity samples and the "unit-cost" drilling contract will allow for a more efficient investigation.

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TABLE 3-9

PROPOSED OFFSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE

Well No.	Depth	Const. Type	Direction From Site	Purpose					Notes
				Water Quality	GW Flow Directions	Vertical Gradients	Secondary Source Area I.D.	SW/GW Inter-actions	
MW-201A	S	OB	W	X	X	X			Between site and quarry to the west. Provide data regarding influence of quarry pumping on groundwater flow directions and contaminant migration from site.
MW-201B	M	PVC	W	X		X			Between site and quarry to the west. Provide data regarding influence of quarry pumping on groundwater flow directions and contaminant migration from site.
MW-201C	D	PVC	W	X	X	X			Between site and quarry to the west. Provide data regarding influence of quarry pumping on groundwater flow directions and contaminant migration from site. Check to see if quarry is deep groundwater discharge point.
MW-202A	S	OB	S	X	X	X	X		Between site and contaminated wells to the south. Determine whether plant south of site may be potential secondary contaminant source area.
MW-202B	M	PVC	S	X		X	X		Between site and contaminated wells to the south. Determine whether plant south of site may be potential secondary contaminant source area.
M2-203B	M	PVC	S	X	X		X		Determine water quality south of the plant/contaminated residential well area.
MW-204A	S	OB	N	X	X	X			Determine water quality between site and residential area to the north.
MW-204B	M	PVC	N	X		X			Determine water quality between site and residential area to the north.
MW-205A	S	OB	N	X	X	X		X	Near ponds northeast of site. Determine whether site groundwater is migrating to ponds. Determine whether groundwater is discharging to ponds.

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